PUBLIC WORKS

An Engineering and Construction Monthly

310 EAST 45TH ST. NEW YORK, N. Y.

CITY COUNTY STATE

Vol. 61 April, 1930 No. 4

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With Our Contributors 4

With Our Contrbutors:

On pages 4, 6 and 8, in the front section will be found information regarding our contributors. The space on this page has been so limited that little more than brief mention of them has been possible, while in the new location, ample room is available for both brief biographies and small photographs. We hope our readers will enjoy knowing more about the men who are contributing to their information and knowledge.

Stretching the Road Dollar:

In line with our policy of publishing articles of maximum value on the low-cost road problem (and on other problems as well) we will publish in the May issue the first of three articles by George E. Martin, on "Making the Road Dollar Go Farther." Prof. Martin was formerly in charge of highway engineering at Purdue, and now is consulting engineer to the Barrett Co. His extremely wide experience makes these articles of much value to the road builder faced with the problem of stretching road funds.

Our New President:

After more than twenty years as president of PUBLIC WORKS, Mr. S. W. Hume has retired from active participation in the business. J. T. Morris, for many years the manager and treasurer, has been elected president, and W. A. Hardenbergh, associate editor, becomes vice-president. Mr. Hardenbergh has been identified with PUBLIC WORKS since 1914, except for a period of war service and for a time immediately after the war when he was engaged in engineering work in the south.

1000 County Engineers:

Returns from nearly a thousand county engineers will feature the May isssue. Information on the amount and kind of work done, and on various practices in construction and maintenance will be contributed from live wire counties all over the United States. No, we can't run biographies and pictures of all our one thousand contributors to the May issue, but we'd like to.

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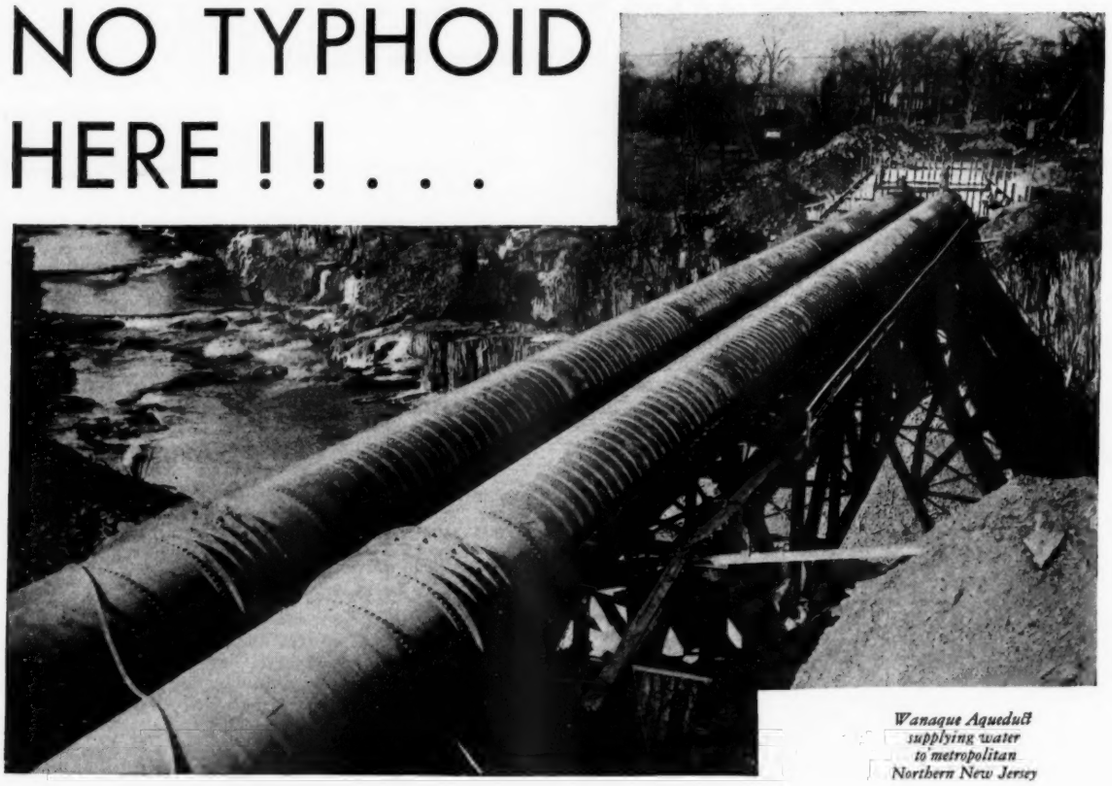
PUBLIC WORKS is devoted to the design, construction, maintenance and operation of *public improvements.*

The major subjects covered are: Highways, Water Supply, Sewerage, Refuse Collection and Disposal, Street Cleaning, Bridges, etc.

Every progressive step is accurately and faithfully recorded.

NO TYPHOID HERE ! ! . . .



Wanaque Aqueduct supplying water to metropolitan Northern New Jersey

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Twenty-nine billion gallons of water are stored in the man-made lake at Wanaque, New Jersey. One hundred million gallons of water a day will be distributed to Newark and other cities in metropolitan North Jersey through a twenty-five-mile steel conduit. Before this water could be distributed, the State Department of Health required that the conduits be sterilized—a proper health regulation.

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PUBLIC WORKS

CITY COUNTY STATE

AN ENGINEERING AND CONSTRUCTION MONTHLY

Vol. 61 April, 1930 No. 4

Experimental Activated Sludge Plant At Philadelphia

With a collector speed of 1 foot per minute, an aeration period of 3.75 hours, and a setting period of .79 hour, satisfactory effluent can be obtained

By Major Michael J. Blew

As density of population progresses the sewage pollution of our main waterways is approaching the allowable limit, even when plain sedimentation of the sewage is provided, and conditions are reaching the point where biological oxidation must be installed to provide additional clarification and purification.

Because of the value of land in and near our large cities and the scarcity of available sites for treatment works, the activated sludge process seems to offer a logical solution to the problem of providing further oxidation to our waste waters before entering our streams.

To study the effect of aeration and partial aeration on its combined sewage, and to study the period of aeration and sedimentation necessary, the city of Philadelphia installed a small experimental tank at the Northeast Works during the summer of 1929. This consisted of a small activated sludge tank and a sedimentation tank provided with a mechanical collector, the former receiving sewage from a primary sedimentation tank.

The aeration tank is 56½″ diameter and the effective depth is 57″. It holds 567 gallons. The settling tank is 16″ wide, 15″ deep and 100″ long. It holds 104 gallons. Figure No. 1 shows the arrangement of the units. Settled sewage is pumped from a primary sedimentation tank by a 1-inch gear pump to a submerged orifice box located above the aeration tank. The volume of flow through the plant is controlled by the size of the opening in the orifice box. The measurements for calibrating this orifice were made by timing the filling of a one gallon container.

The bottom of the aeration tank is of the ridge and furrow type. There are three furrows, each containing a pipe perforated with 5/64″ holes at 4″ centers. There are 34 holes altogether. Air is supplied by a reciprocating compressor about a thousand feet away. The compressor pumps up a receiver to 80-lbs. pressure, stops and starts again when the air in the tank is used up. Due to the variation of air pressure, the surface elevation of the mixed liquor and in consequence the flow to the final settling tank varies greatly. A deep, inclined baffle in front of the overflow weir protects this weir from the rising air bubbles.

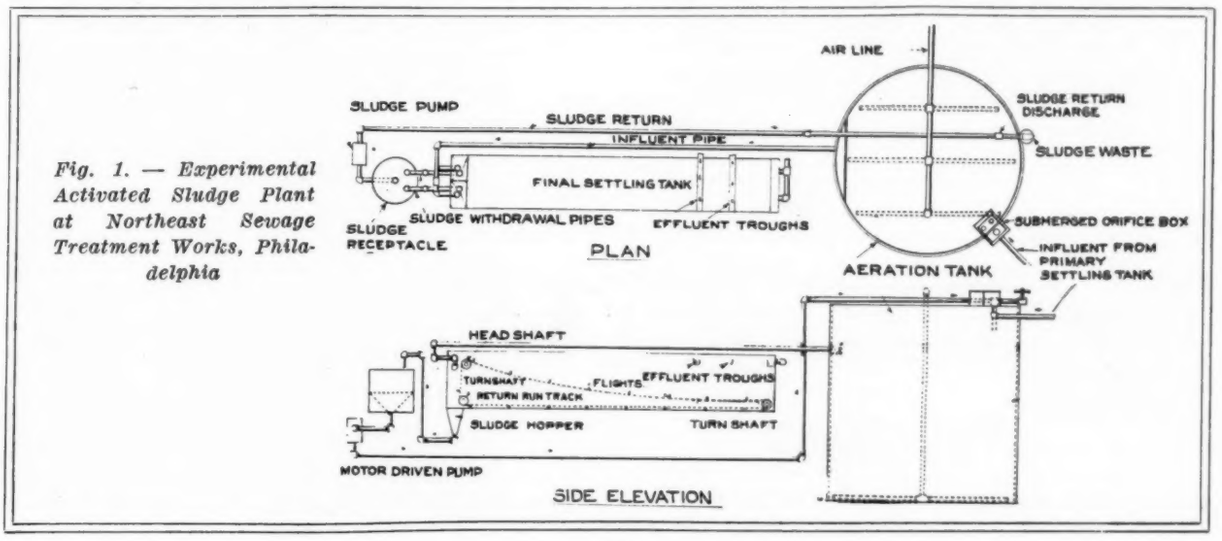
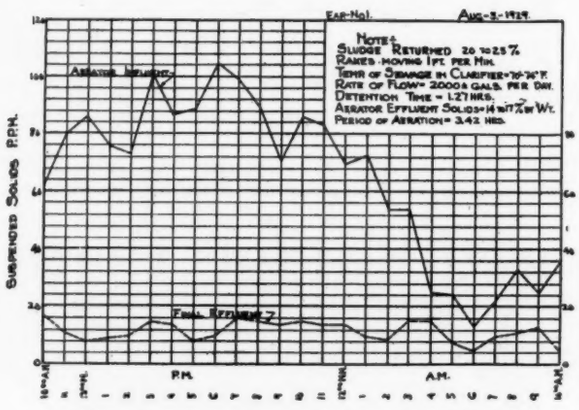
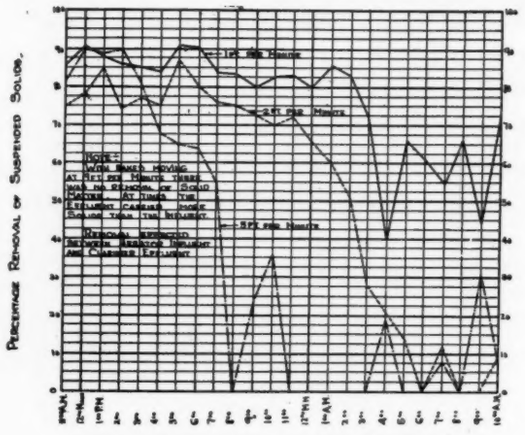


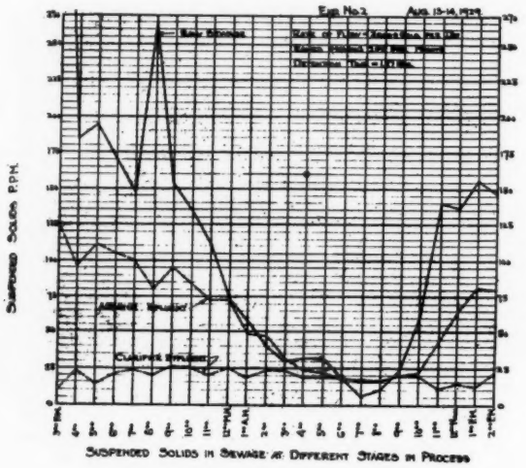
Fig. 1. — Experimental Activated Sludge Plant at Northeast Sewage Treatment Works, Philadelphia


Exp. No.1 Aug.-3-1929
NOTES:
SLUDGE RETURNED 20 TO 25 %
RAKES MOVING 1 FT. PER MIN.
TEMP. OF SEWAGE IN CLARIFIER = 70°-74° F.
RATE OF FLOW = 2000 GALS. PER DAY.
DETENTION TIME = 1.27 HRS.
AERATOR EFFLUENT SOLIDS = 1.4 %
PERIOD OF AERATION = 3.42 HRS.
AERATOR INFLUENT
FINAL EFFLUENT
SUSPENDED SOLIDS P.P.M.
P.M.
A.M.

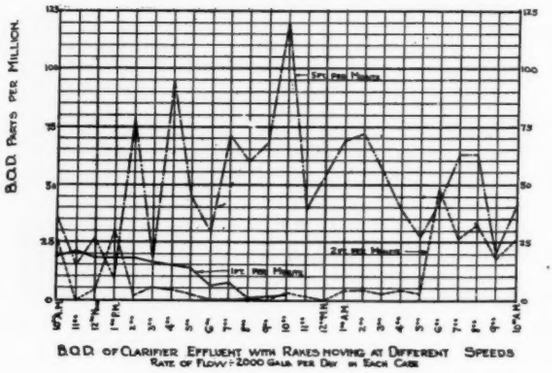
REMOVAL TEST ON LINK BELT CLARIFIER ON ACTIVATED SLUDGE



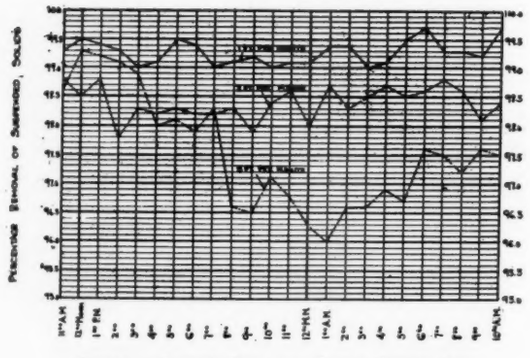
REMOVAL OF SUSPENDED SOLIDS WITH RAKES AT DIFFERENT SPEEDS



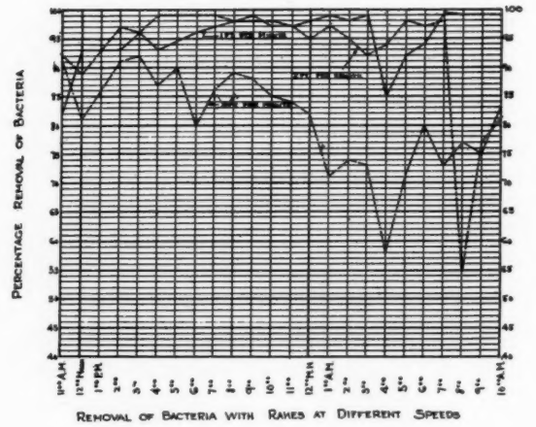
SUSPENDED SOLIDS IN SEWAGE AT DIFFERENT STAGES IN PROCESS



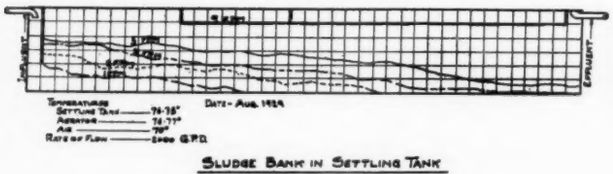
B.O.D. OF CLARIFIER EFFLUENT WITH RAKES MOVING AT DIFFERENT SPEEDS
RATE OF FLOW = 2000 GALS. PER DAY IN EACH CASE



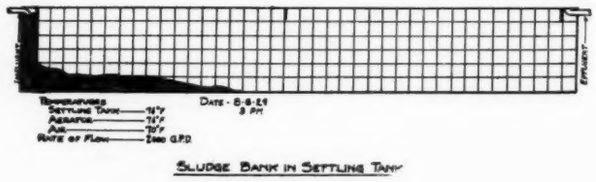
REMOVAL OF SUSPENDED FLOC WITH RAKES AT DIFFERENT SPEEDS
REMOVAL EFFECTED BETWEEN CLARIFIER INFLUENT AND CLARIFIER EFF.



REMOVAL OF BACTERIA WITH RAKES AT DIFFERENT SPEEDS



SLUDGE BANK IN SETTLING TANK
COLLECTOR SPEEDS AS SHOWN



SLUDGE BANK IN SETTLING TANK
COLLECTOR SPEED 1 F.P.M.

Charts Above Show Results Obtained at the Experimental Plant Under Different Conditions of Operation. Below Are Shown Relation Between Sludge Banks and Collector Speed

The final settling tank, Fig. No. 3, is glass and equipped with a Link-Belt "Straight-Line" collector, made to a scale one-twelfth the standard size. The influent pipe is divided into two parts and the incoming flow directed against the wall at the influent end. The effluent channels may be placed at any part of the tank, but the channel at the end opposite to the influent end took most of the flow in all cases. The collector moves the sludge to two hoppers at the influent end of the tank. Sludge was discharged by gravity into a small hopper and returned to the aeration tank by a ½" gear pump. Sludge could be wasted by an overflow from the hopper or by a valve at the end of the sludge return line.

The aeration tank was started with 10 gallons of sludge from the Tenafly plant. Settled sludge was added every day until the aeration tank contained 20% sludge. After that the plant was operated at a rate of 2000 g.p.d., which gave a period of detention of 5.5 hours in the aeration tank and 1.27 hours in the settling tank. In calculating the detention period of the aeration tank, a 25% sludge return was added to the incoming flow. The sludge return is omitted in figuring the detention period of the final tank, as the sludge returned is taken from a place directly below the influent and does not affect the settling capacity of the tank.

The arrangement of the influent pipes gave a fair distribution of the mixed liquor across the section of the tank, but the surface velocity was so high that a shallow baffle was placed about 36" from the influent. A deep baffle close to the influent end proved of great benefit, especially with large flows. The top of this baffle was placed about ½" below the surface of the liquid to prevent the accumulation of scum at the inlet.

It soon became evident that the speed of the collector was the most important factor in the settling of the sludge; in fact, the only difference between a collector and an agitator is the speed of the mechanism. Test runs were made with the collector running at one, two, three and five feet per minute. The diagrams show the results obtained.

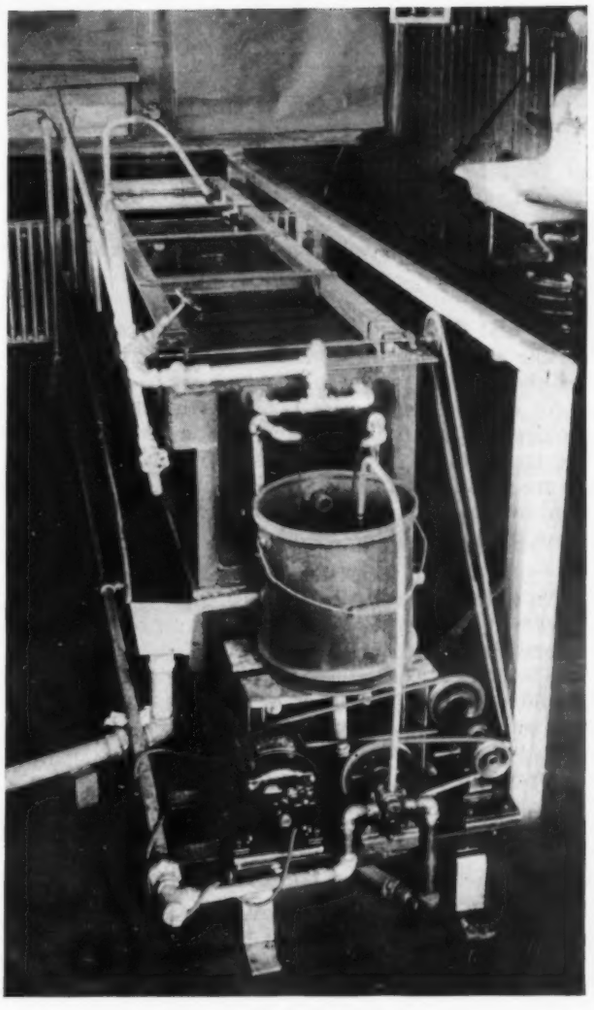


Fig. 3.—Final Settling Tank

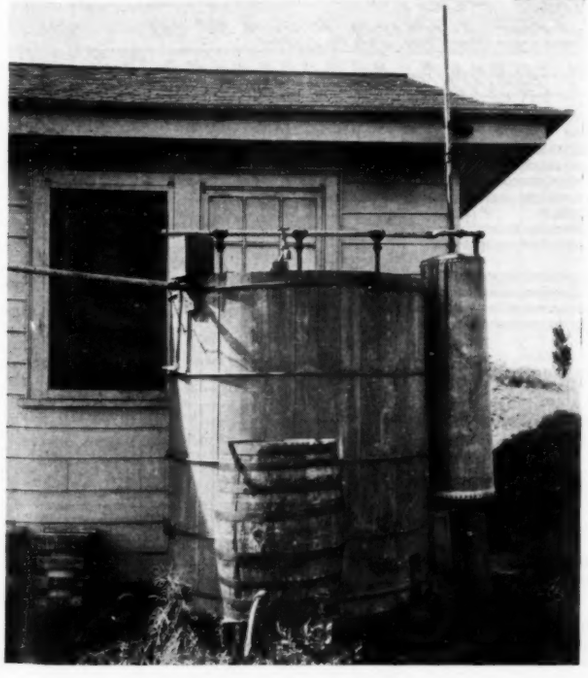


Fig. 2.—Aeration Tank

The sludge was typical activated sludge, possessing a good color and settling rapidly, as shown in Fig. No. 4. Samples were taken every hour for twenty-four hours and a separate analysis made of each sample. This method gives a much clearer picture of the operation of the plant than combined samples would and removes errors due to variations in flow of sewage through the plant.

The results of the analysis indicate that a collector speed of 1 f.p.m. or less is the most advantageous. Two f.p.m. is the maximum permissible rate of speed, although there does not seem to be any reason for running the collector at this velocity. At 1 f.p.m., the collector brings as much sludge to the pump as it is able to handle. This held true even when the flow was increased to 3300 g.p.d. and the detention period in the tank was decreased to .79 hour. The short detention period in the aeration tank affected the quality of the effluent, although no difficulty was experienced in running the plant at this high rate.

In December the air was shut off for five days. When the plant was started up again the sludge was

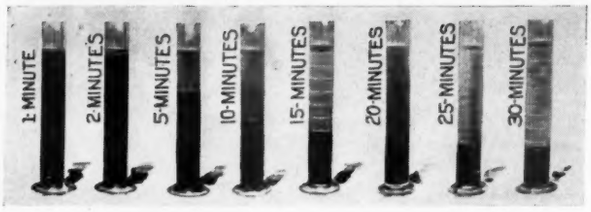


Fig. 4.—The Sludge Has a Good Color and Settles Rapidly

bulky and settled very slowly in a 100 c.c. cylinder. At the same time, it settled much better in the tank and the effluent was good.

No measurements were taken of the volume of air required, as any figures obtained under present operating conditions would not be used in the design of a future plant. To obtain reliable data on air consumption an experimental tank of the same dimensions as those to be used in the ultimate design should be built.

SUMMARY

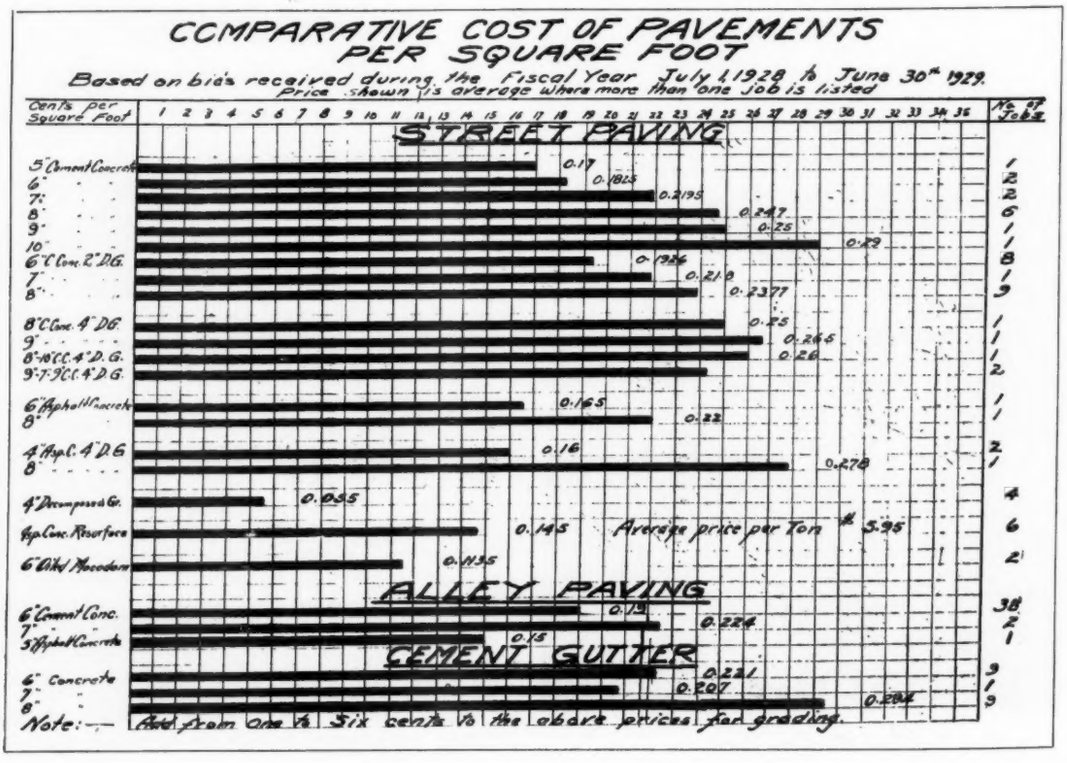
An effluent that can be discharged into large waterways without creating a nuisance can be obtained with an areation period of 3.75 hours and a settling period of .79 hours. The collector speed in the settling tank should not exceed one foot per minute, sludge return pumps should be of ample capacity, and enough units should be installed to return 50% of the flow, especially at this high rate of operation.

Costs of Paving and Street Improvement in Long Beach, Calif.

Through the kindness of W. E. Butler, assistant office engineer of Long Beach, California, we have been furnished with average prices of improvement work for which bids have been received during the past year.

	Average Price Per Sq. Ft.	No. of Jobs
Street Paving		
6″ Asphalt Concrete	.185	1
2″ Asphalt Concrete top—6″ Concrete Base	.230	1
6″ Asphalt Concrete—4″ D.G.	.185	1
4″ Asphalt Concrete—4″ D.G.	.175	2
6″ Cement Concrete	.164	2
6″ Cement Concrete—3″ D.G.	.190	1
6″ Cement Concrete—2″ D.G.	.170	1
7″ Cement Concrete	.180	1
8″ Cement Concrete—4″ D.G.	.220	1
4″ Decomposed Granite	.04975	2
	Per Ton	
Asphalt Concrete Resurface	4.425	2
Alley Paving		
7″ Cement Concrete	.222	1
6″ Cement Concrete	.181	21
5″ Cement Concrete	.136	2
Cement Gutter		
6″ Concrete Gutter	.200	11
8″ Concrete Gutter	.222	5
Combined Curb and Gutter		
	Per Lin. Ft.	
Combined Curb and Gutter	.95	1
Curb and Curb Armor		
	Per Lin. Ft.	
Cement Curb	.426	31
Curb Armor	.425	28
Sidewalk and Cross Walk		
	Per Sq. Ft.	
3½″ Cement Concrete Sidewalk	.141	28
6″ Cement Concrete Sidewalk	.213	10

Note—Add from 1 to 6 cents per sq. ft. to the above prices for grading.


COMPARATIVE COST OF PAVEMENTS PER SQUARE FOOT
Based on bids received during the Fiscal Year July 1, 1928 to June 30th 1929.
Price shown is average where more than one job is listed
Cents per Square Foot
No. of Jobs
STREET PAVING
5" Cement Concrete
6" " "
7" " "
8" " "
9" " "
10" " "
6" C Conc. 2" D.G.
7" " "
8" " "
8" C Conc. 4" D.G.
9" " "
8"-10" C.C. 4" D.G.
9"-7"-9" C.C. 4" D.G.
6" Asphalt Concrete
8" " "
4" Asph. C. 4" D.G.
8" " "
4" Decomposed Gr.
Asph. Conc. Resurface
6" Oiled Macadam
Average price per Ton $ 5.95
ALLEY PAVING
6" Cement Conc.
7" " "
5" Asphalt Concrete
CEMENT GUTTER
6" Concrete
7" "
8" "
Note:— Add from One to Six cents to the above prices for grading.

Methods and Cost of Highway Maintenance in South Carolina

Control of the work is facilitated by maintenance shops located in more than half the counties; resurfacing; grassing and protecting highway shoulders; marking the highways

By W. L. Hardeman*

South Carolina's state highway system, the aggregate length of which is approximately 6,000 miles, affords some interesting problems in the study of modern maintenance methods. The topography varies from the coastal plane, where the question of drainage is of greatest importance, to the highly rolling or mountainous sections where the runoff of surface water is frequently so rapid as to cause serious erosion. The characteristics and behavior of the different types of soil afford ample opportunity for study of the different methods which must be employed for effective maintenance that will keep the highways in good condition for travel the year round. Every maintenance employee, through actual experience, gets to know in the course of time the drainage peculiarities and vulnerable spots in the territory under his supervision, whether it be division, district, county or patrol; but a central state organization must be counted on to coordinate knowledge from all over the state, to anticipate trouble and prepare for it, so that emergencies may be handled promptly.

Type of Highway Signs Used in South Carolina

Expenditures and Cost Data—At the present time the department spends approximately two and one-half millions of dollars annually for maintenance of its highways. This budget covers the cost of new equipment, supplies, supervision and payrolls; separate allotments are made by the State Highway Commission, as the needs arise, for betterment work, construction of maintenance shops in the different counties, and experimental projects.

Some idea of the costs of maintenance in South Carolina may be gained from the following summarized record, which shows the average cost per mile, exclusive of costs for supervision and new equipment, for all types of surfacing over the past five years:

1924	$368.86
1925	372.17
1926	376.44
1927	334.13
1928	359.94

The cost of marking the highways was not included in computing the average cost per mile for maintenance during the years 1924, 1925 and 1927, while the figure for the year 1928 includes the major portion of a $635,000 fund set aside to cover repairs to roads and bridges damaged by the heavy rainstorms which occurred in August and September of that year.

Operations—Maintenance operations which constantly engage the attention of the department are too numerous to be covered fully; therefore, brief mention will be made of only a few. In addition to the routine operations such as dragging, machining, ditching and renewing surface on soil roads, and patching, filling cracks, rebuilding shoulders, cleaning ditches and mowing grass on shoulders on hard-surface roads, the department is carrying out various programs which will tend further to systematize the work of providing for the traveling public the best possible roads during all seasons of the year.

Maintenance Shops—The department owns its maintenance stations in slightly more than half of the forty-six counties at the present time, sites being purchased and buildings of standard design being erected as fast as funds will permit. These outposts placed on a site of at least an acre in area, consist of a combination repair shop and office, truck shed, blacksmith shop and oil house. The standard shops thus far constructed have been erected by the department's maintenance forces and are built of galvanized metal on wood frame with concrete floors for all buildings except the truck shed. The average cost for the four buildings has been in the neighborhood of $5,000.

Located at the most advantageous point in the county from the standpoint of accessibility to the highways, generally near the outskirts of the county seat, and being in full view of passing motorists and a source of pride to the superintendent, a state maintenance shop presents a pleasing appearance with its well groomed grounds and high wire fence.

Some of the larger counties have, in addition to the centralized station, patrol sheds for the purpose of storing equipment at the more distant points where it

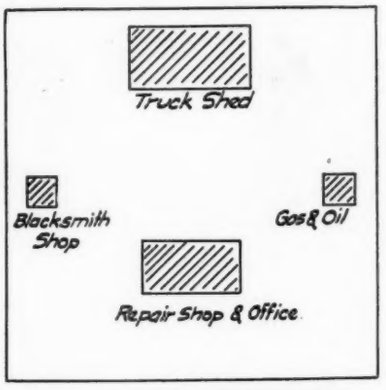
* Assistant to the Maintenance Engineer, South Carolina Highway Department.

is impracticable to bring the equipment to the main shop each night.

Surface Treatment—The department, in an effort to obtain a road surface which would be independent of weather conditions and at the same time present a smoother riding surface than the untreated soil road, has been treating some of the more heavily travelled sections of road with bituminous materials.

A portion of the surface treatment on the state highway system at present was constructed jointly with the Bureau of Public Roads, the work being of an experimental nature. However, such satisfactory results have been obtained with this bituminous surfacing that there is now 52 miles of such treatment being constructed in one county by contract, and the construction of several hundred additional miles is contemplated under the pending bond issue. The treatment in general consists of applying a prime coat of light tar to the prepared earth type surfacing at the rate of approximately 0.3 gallon per square yard, followed by a hot application of asphaltic oil applied at the rate of approximately 0.4 gallon per square yard, and then covering with crushed stone at the approximate rate of 50 pounds per square yard.

Of the total mileage of completed surface treatment included in the state highway system at the present time (approximately 325 miles) 286 miles were constructed by the maintenance forces under the supervision of the various department and division heads.



Layout of Standard Maintenance Shop

Re-Surfacing—In the spring months of each year a re-surfacing program is carried out. Sections of highway which have suffered heavy losses of surfacing during the winter months are re-surfaced. The winter rains take heavy toll of the earth type highways and thousands of cubic yards of material are required to replace that which is lost during the winter on account of erosion. The task of hauling and placing this material is accomplished by the maintenance forces without any appreciable courtailment of routine operations, or employment of outside aid.

Grassing of Shoulders—Good progress has been made toward the grassing of shoulders of the paved highways on the system. As a general rule bermuda grass sod has been used, but in a few instances where the sod has not been readily obtainable, it has been necessary to sow seed. Due to the difficulty experienced in getting bermuda grass seed to germinate except under the most favorable conditions and with a great deal of cultivation, rye grass seed has been used with a certain measure of success. The freshly sodded or newly planted shoulder is protected as much as possible from harmful agencies and all maintenance work which might be injurious to the growing grass is dispensed with as far as practicable until the grass is rooted firmly to the shoulders. This sodding and planting has already resulted in a decrease of shoulder maintenance and has minimized the loss of material which the shoulders have heretofore suffered during periods of heavy rainfall.

Marking the Highways—Realizing the value of a well marked highway system, the department is continuously engaged in constructing and erecting directional and warning signs necessary to guide the stranger to any desired destination with the least possible distance and confusion.

The program of marking interstate highways with signs which were standardized and adopted by the Bureau of Public Roads and the American Association of State Highway Officials has practically been completed, with the exception of those sections which have recently been under construction. Thousands of metal signs are purchased and many wooden ones constructed at the supply depot and at the maintenance shops each year and erected by the maintenance forces.

Future of the State Highway System—With the state launching a program calling for the expenditure of the proceeds from a $65,000,000 bond issue for the completion of the state highway system within the next four years, the future of South Carolina's road system appears bright. The construction of approximately 2,000 additional miles of paving and approximately 1,500 miles of semi-hard surfaced and soft surfaced roads, as well as the replacement of all temporary bridges with those of a more permanent nature, is contemplated.

The completion of such a program will give South Carolina a system of highways the state may well be proud of, and one that will compare favorably with other states of greater area, wealth and population.

The results of such an undertaking as outlined above, besides being beneficial in many other ways, will undoubtedly effect many changes in the present methods employed in maintenance. Equipment may then be standardized to a greater degree, more permanent assignments may be made among the personnel and, while the tasks of some will become less burdensome, responsiblity will be increased in many instances.

Allegany Completes New Sewage Treatment Plant

The village of Allegany, N. Y., has recently completed a sewerage system and treatment plant, which was constructed at a cost of $110,000. It comprises nearly six miles of sewers and a sewage treatment plant consisting of an Imhoff tank and sludge drying bed of glass-covered construction.

All sewers within 200 feet of the drilled wells from which the water-supply of the village is obtained, are constructed of cast-iron pipe with tight lead joints for the purpose of eliminating any possibility of contamination of the water supply.

Solid Tires on Trucks Disappearing

Motor vehicle registration figures from California reveal that solid tired trucks are fast disappearing from the highways. During 1928 the registration of solid trucks totaled 36,618, as compared with similar registration of 20,543 in 1929.

Levee Work in the Northern Area, Vicksburg Engineer District

Hauling with tractors and trailer wagons used principally for moving dirt; loading by elevating grader and small dragline. 4½-yard diesel draglines also used in cooperation with hauling units.

Much levee enlargement and some new construction work is going on in the Vicksburg district of the Mississippi River Commission. On nearly all this work, the rule is large contracts extending over a considerable area. The average contract in this vicinity runs to 1,250,000 cubic yards and upward, and the usual time allowed on these contracts is 1,000 calendar days.

The Vicksburg Engineer District is divided into five areas: North, Central, Southern, Western and Arkansas. In the Northern area are nine levee contracts aggregating around 12,500,000 cubic yards of earthwork. A variety of methods of construction are being employed here.

Contract No. 1.—The total yardage on contract No. 1, which begins at the Coahoma-Bolivar county line and extends southward, amounts to 1,393,000 cubic yards. This is being done by United States machine No. 13, which is a tower machine, the work being done on a hired labor basis. The work consists of riverside enlargement of existing levees. The government bid price was 22.34 cents per cubic yard.

Contract No. 2.—This work, which is riverside enlargement totalling 1,306,000 cubic yards, was bid in at 30.97 cents per yard by R. T. Clark, Inc., Delta Construction Co., and John Noble. About 550,000 cubic yards has been sublet to C. C. Aderholdt of Memphis. All the work on this section is being done by tractors and trailer hauling equipment supplemented by teams. Aderholdt has on this job—known as the Round Lake Levee—three caterpillar "60" tractors; three Monarch "75" tractors; four Western 5-yard crawler wagons working in teams of two each; three Streich 7-yard crawler wagons; and a Northwest 1-yard gasoline dragline with which he loads the wagons.

Also on this section of the job are three wheel scrapers; one fresno; three elevating graders; five tractor wagons; four tractors, and other minor equipment.

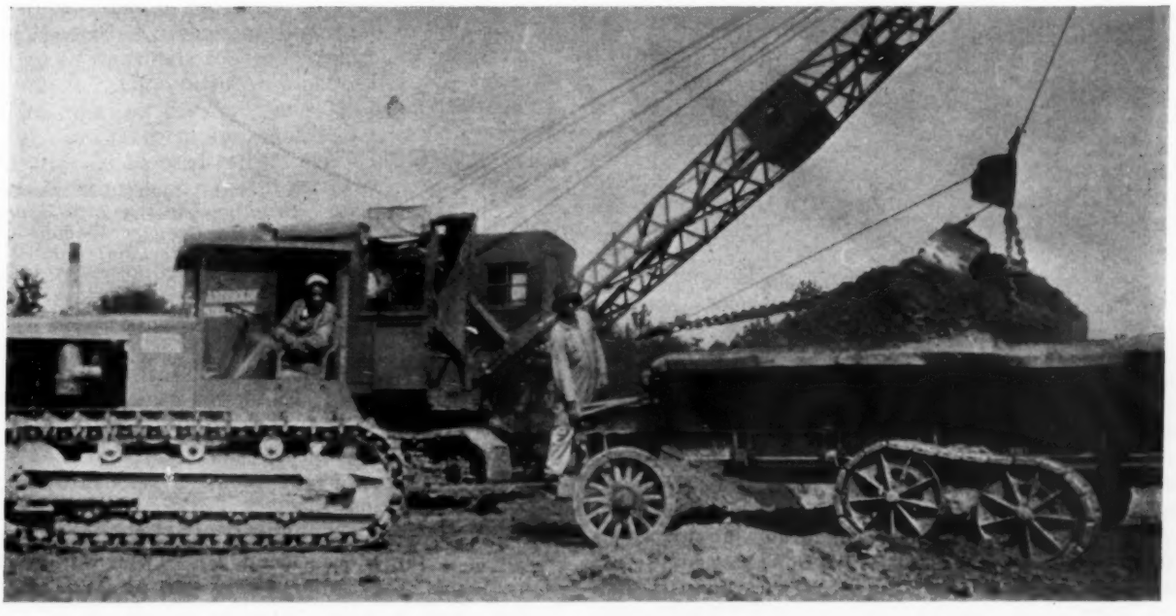
Contract No. 3.—The Hurricane Point Levee aggregates 1,672,000 cubic yards, which is mostly riverside enlargement. This is being done by the government with hired labor, by Tower machine C-8. The government price on this section was 21.68 cents.

Contract No. 4.—No work is being done on this section.

Contract No. 5.—This section is just above the Rosedale levee. It consists of 1,433,000 cubic yards of riverside enlargement, which is being done by the government by hired labor at the contract price of 28.37 cents per yard.

Contract No. 6 has not been awarded.

Contract No. 7.—This contract involves 698,000



Northwest Dragline Loading; Monarch "75" Tractor and Streich Crawler Wagons Working on Contract No. 2, C. C. Aderholdt

cubic yards of riverside enlargement above the Beulah levee. The contractor on this job is W. G. Sumerville & Co., who bid the work in at 24.47 cents. This firm is working a Lima "101" dragline on the job.

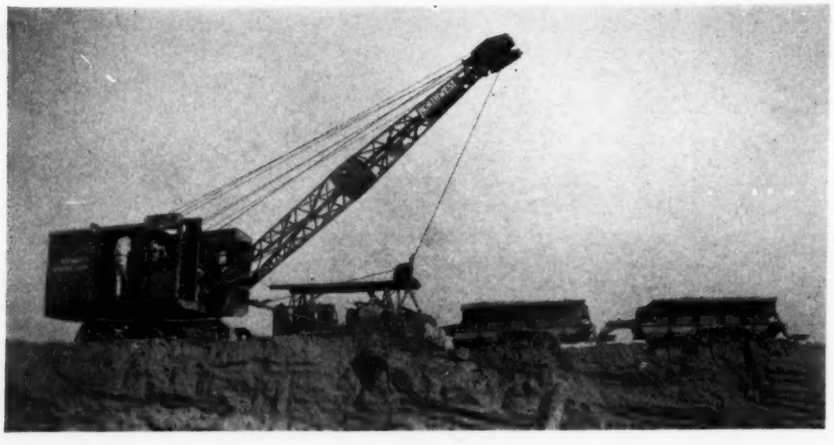
Contract No. 8.—The riverside enlargement of the Beulah-Lake Vermillion levee went to the Orleans Dredging Co. at 35.47 cents per yard for 2,400,000 yards. This work is being done by the hydraulic fill method, pumping by dredges from borrow-pits along the river.

Contract No. 9.—This is a hauling job involving riverside enlargement along the Bolivar Bend levee. It was awarded to Lowrance Bros. & Co., at 26 cents per yard on a contract yardage of 1,326,000. On this job the contractors have four teams; one wheel scraper; four crawler wagons; one elevating grader and five tractors.

Other Work—Across the river at McGehee, Ark., Sternberg & Co. have a large job on loop construction, in which they are combining the use of tractor-trailer teams and large draglines. For the base section, hauling outfits are used. On the job are four crawler wagons; one Linn tractor; one elevating grader with power take-off; four caterpillar tractors; and one P & H diesel 1¼-yard dragline. This dragline operates on a fuel cost of only about $3 per day or $1.50 per 10-hour shift.

AT THE LEFT: *On the Receiving End. Western 5-Yard Wagons Being Loaded by Northwest Shovel*

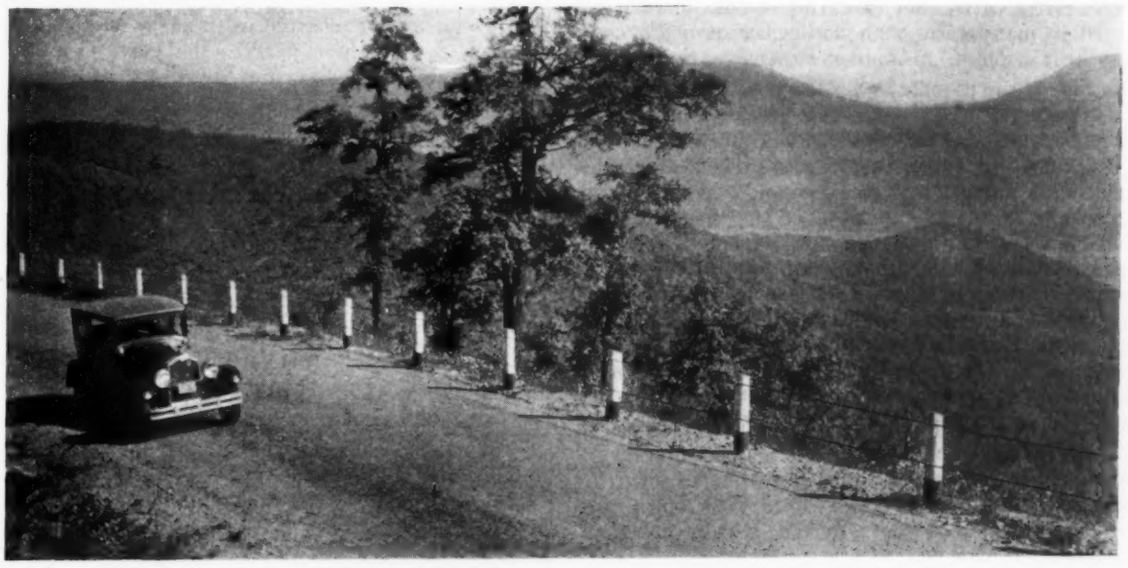
AT THE RIGHT: *At the Dumping End. Caterpillar Tractor and Western Wagons Add 10 Yards More to the New Levee*



AT THE LEFT: *Northwest Dragline Loading Two 5-Yard Western Crawler Wagons on the Aderholdt Job*

PERSONNEL

The Vicksburg Engineer District is under the charge of Major J. C. H. Lee, with Major Thos. B. Larkin, as chief of the operations section. R. C. Lilly, associate engineer, is in general charge of levee work. E. S. Maupin with his office at Rosedale, Miss., is in charge of the northern area of the district.



U. S. 50 in the Alleghany Mountains in West Virginia. Local Sandstone "Puddle Macadam" Four Years Old. Total Bitumen 1¼ Gallons Per Square Yard

Low-Cost Surfaces and Surface Treatment*

Methods of surface treatment are classified as to purpose and details of procedure. Patching. Penetration. Macadam. Gravel. Shale. Costs of Asphaltic treatments.

By B. E. Gray
Division Engineer, West Virginia State Road Commission.

The greater use of low-cost types of surfacing is the answer to the problems offered by the need for development of greater mileage of highways and the raising of the funds for this purpose. Wherever it is possible to make surfaces which will give adequate service at a low cost by using local materials immediately available to the roadside, such a type certainly should be used rather than arbitrarily selecting some high type purely for reasons of sentiment or because of public clamor.

By a low-cost road we do not mean one having only a narrow section paved with expensive material. This would not be a low-cost road but would prove the most costly, because eventually the roadway will have to be widened, structures lengthened and alignment revised, so that the expensive surfacing will have to be discarded long before the end of what should have been its useful life.

A true low-cost surface is one which is placed upon a graded roadway of such width as will take care of the traffic for years to come, with but little additional expenditure of funds other than for increasing the carrying capacity of the surface itself. This applies to all county work as well as state highway work. It it far better to grade the road properly to adequate width, with long culverts and proper drainage, omitting the surface entirely for the time being, rather than to attempt to make a one-way, half-way piece of work by combining both inadequate width and improper surfacing. This has been the policy adopted by West Virginia. For several years we have had on certain sections roads that are graded only, but they have been of wide cross-section, and as soon as funds are available, rapid extension of the pavement is carried on. This policy allows for settlement of fills and stabilization of weak places, so that when the pavement is laid its useful life will be much longer.

It should not be thought that low-cost surfaces can be placed in a hit or miss fashion and without any regard for engineering principles. Low-cost surfaces that are producing satisfactory results throughout the United States are those which have been developed as the result of intensive and careful research, and their construction requires expert knowledge of the physical, chemical and mechanical characteristics of the materials employed, and an attitude of mind which is receptive to new methods, and a keen discrimination. Low-cost improved roads will continue to include more than 50 per cent of all the surfaced mileage in the United States for many years to come, and during the past three years there has been a tremendous impetus given to this character of construction, and all high-

*Condensed from a paper presented at the annual meeting of the West Virginia Road Builders' Assn., held at Charleston in December, 1929.

way engineers and officials have been casting about to determine if a satisfactory wearing surface cannot be obtained in many cases without the use of brick, concrete, sheet asphalt and other expensive pavements.

The test of the economy of a low-cost surface is met when the annual maintenance cost is less than the difference between the fixed charges on such a surface and that of a high type. A low-cost surface should be of such nature that stage construction is possible and that, within reasonable limit, as traffic increases the surface may be strengthened and widened, utilizing all previous work. A case in point would be where a gravel or shale or slag was placed carefully to line and grade, maintained with a bituminous treatment, and several years later, after thorough stabilization, utilized as a base for a wearing course of bituminous macadam or similar topping.

At the meeting of the U. S. Highway Officials in 1929, the design committee recommended that every state have a planning committee within its own organization which would endeavor to work out a program over a period of years, to come within the appropriations to be expected.

The following strong indications were found in the recent study of low-cost roads made by the Highway Research Board:

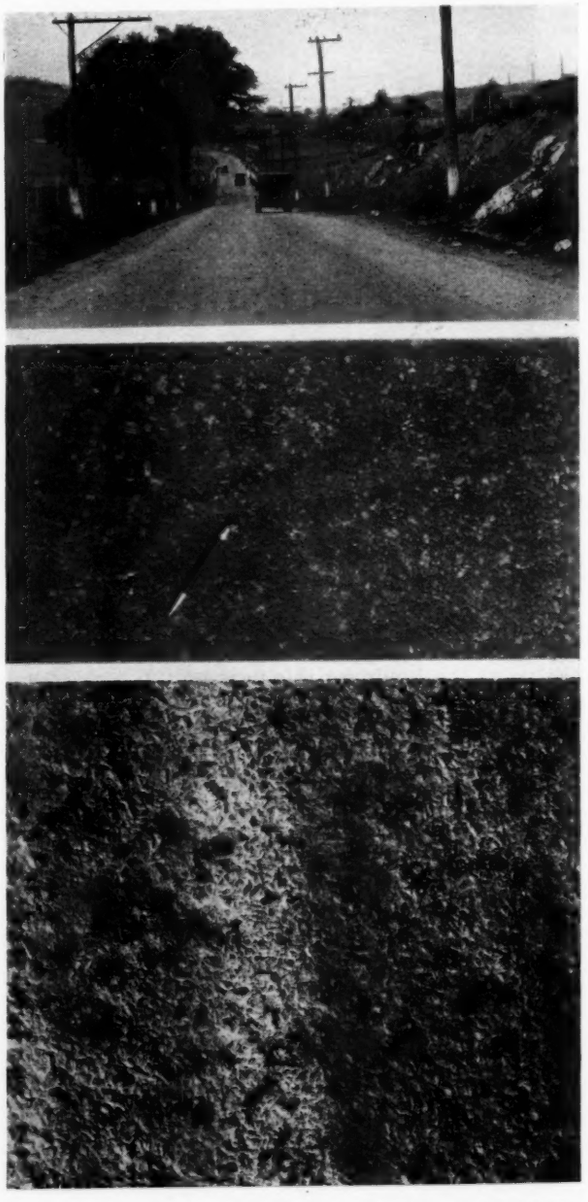
1. Relatively expensive high-type pavements have been constructed where a surfacing costing less than half the amount would have furnished adequate service. Relatively low-cost untreated surfaces have been and are being laid where probable future traffic will warrant the pavement type; but they are considered a good investment as a subgrade treatment and they are giving reasonably good service in certain instances during the time required for the stabilization of new embankments.
2. Soft aggregates can be used more economically in a base course than in a surface course.
3. Surfaces constructed or maintained by blading or by dragging should be composed of aggregates passing the 1 or ¾-inch screen.
4. Tar products of low viscosity are generally preferred for penetration prime coats on previously untreated surfaces; but satisfactory results are claimed in certain localities where asphalt products are used for prime coats.
5. Either asphalt products or tar products give good results as subsequent applications. They are of higher viscosity than the prime coats.
6. Preference for asphalt products is found in certain locations. Preference for tar products is found in other places. Several localities use both asphalt and tar products for surface treatments.
7. Asphaltic cement is preferred for bituminous penetration macadam.
8. Asphalt products and tar products are used for pre-mixed bituminous surfaces which are laid at atmospheric temperatures.
9. Asphaltic cement is preferred for pre-mixed bituminous surfaces which are laid hot.
10. Improved construction and maintenance methods are making low-cost roads more popular within the recent years because of the more durable and smoother riding surfaces which are obtained.

The following were suggested for further research:

1. The development of standard tests for determining the suitability, proportions and characteristics of aggregates and their gradation for mixed-in-place bituminous surfaces and for pre-mixed-laid-cold bituminous surfaces.
2. The development of bituminous emulsions suitable for cold surface treatments of various types.
3. A determination and classification between limits of the important characteristics of bitumen most suitable for treatments of the surface application, mixed-in-place or other types, together with simplified and reasonably uniform specifications for materials and methods of construction.
4. A study of non-bituminous materials which may now be suitable for surface treatments. and the development of others.
5. A study of finishing methods for pre-mixed bituminous surfaces, with view to developing smoother riding surfaces.

A great deal of research work has been done during the past two or three years. In West Virginia two distinct types have been developed for utilizing local materials, one known as modified bituminous macadam, or familiarly as "puddle macadam;" the other a method of using local shale. All work so far carried on indicates the tremendous amount of knowledge still to be gained, and that highway officials are just beginning to realize how great are the possibilities if only intelligent research is applied.

Considering West Virginia conditions the low-cost surfaces available are those using shale, gravel, cinders, slag and stone base courses, all placed to a width of not less than 20 feet on state roads or 15 feet on county roads. They should be selected after a careful



Hot Asphalt Surface Treatment on Water-Bound Macadam Previously Primed With Cold Liquid Asphalt. Top—6 Years Old. Middle—5 Years Old. Bottom—One Month Old

Road of Local River Gravel in Agricultural Region, Potomac Valley. 1½ Inch Retread Top. Plenty of Cover Coat Prevents Disagreeable Picking Up by Traffic. This Road, 20 Feet Wide, Cost $6,000 Per Mile

study of local conditions and so far as possible utilize materials with minimum freight costs. Research has shown, for example, that a good surface can be made from crushed soft sandstone mixed with clay and maintained with a grader and drag, when the same stone placed as a slab base course would be a total failure. Later a bituminous treatment may be given, and with the wide roadway so that lateral dispersion of traffic is had, a long, useful life at low cost will result.

Considerable width is desirable for low-cost surfaces. There are instances without number where a stone surface 8 inches thick and 15 feet wide has failed under traffic, when with same material and same subgrade a surface 5 inches thick and 20 feet wide has been entirely satisfactory. One advantage of thin sections is that it is possible to build gradually to a stable condition, and if any small break occurs, additional material can be added and gradually worked in. These low-cost surfaces are usually very smooth riding because they are maintained by blading and dragging.

In all work of this character, surface treatments are the final methods of maintenance, and a brief discussion of these methods is given, divided into two parts: 1—Those treatments given to preserve original surface; 2—Those surfaces to which treatments are given as a dust palliative or to improve and build up a better or higher type of surface.

The technique for the first group is very well established as a result of many years' experience, and refinements and changes are brought about only as the manufacture of bitumens is improved. In the second group, however, there is a great field for development, improvement and experimentation.

SURFACE TREATMENT

(a) *Water bound macadam* is a type rather infrequently built today, yet there is a large mileage of such roads in every state highway system in the country which are giving excellent service results where bituminous treatments have been given. The first application consists of a light tar or asphaltic material with a fairly high percentage of volatile elements which evaporate within a short time after application, with a cover coat of ⅜ to ⅝-inch chips. Two successive quarter-gallon applications are better than a single one-half gallon application, and about ten pounds of chips are required as cover coat for each application. The following year a single quarter-gallon application will be required, with successive treatments about every three years under medium traffic, using somewhat heavier material.

(b) *Penetration macadam* should not receive surface treatment until the surface shows pitted and the coarser stone begins to show exposed below the edges. I believe the mistake is often made of giving a surface treatment when all that is required is a little patching and the surface then carried over for another year. I recall some fifteen years ago, before the precision of present-day manufacturing, I worked with a Mr. Charles Howes, who used to say to us every winter when we brought in our recommendations for the following season's maintenance: "A good rule for the time to surface is to let the surface go until it looks like it would go to pieces if it wasn't treated immediately, and then let it go for another year." While we didn't always agree with him, largely on account of the appearance of the road surface, yet it is a fact that to hold a smooth surface, the minimum application that will hold chips is the proper amount. Two types

Cold Mixed Macadam on Stone Base. Wide Section Gives Lateral Dispersion, Longer Life and Less Maintenance

of treatment may be used on penetration, hot material with 1¼" to ¾" chips, and cold with ⅝" to ⅜" chips.

In general, hot treatment is used on sections through the mountains where the coarse chip gives a roughened surface which is non-skid and which will remain in the roughened condition for several years, or else on sections where it is desirable to increase the thickness of the wearing course. Hot treatments, while they do not produce that superior smooth riding surface which is so attractive, yet have a number of advantages. The material sets up almost immediately after application, and as soon as coarse chips are thrown on for cover, traffic can immediately use the road without picking up the chips or getting bituminous material on the car. Two successive hot treatments, however, are never given, as there is a tendency to produce a wavy surface with the additional application, and as the hot material never sets up quite as hard as the cold application. Hot material is applied at the rate of one-quarter to three-eighths gallon per square yards and requires from twenty-five to thirty pounds of chips for cover coat.

(c) *Patching* may also be included in this first group of surface treatments, as it is often difficult to tell where patching leaves off and surface treatment begins. We have been using a cold asphalt patch during the past several years which has been unusually satisfactory. In view of the much less cost of making the poured patch, and because of the very smooth surface that can be obtained, there would seem to be little reason for using the mixed method in ordinary highway maintenance today. This cold patch is used not only as a repair material but as a method of widening narrow pavements (including concrete) and

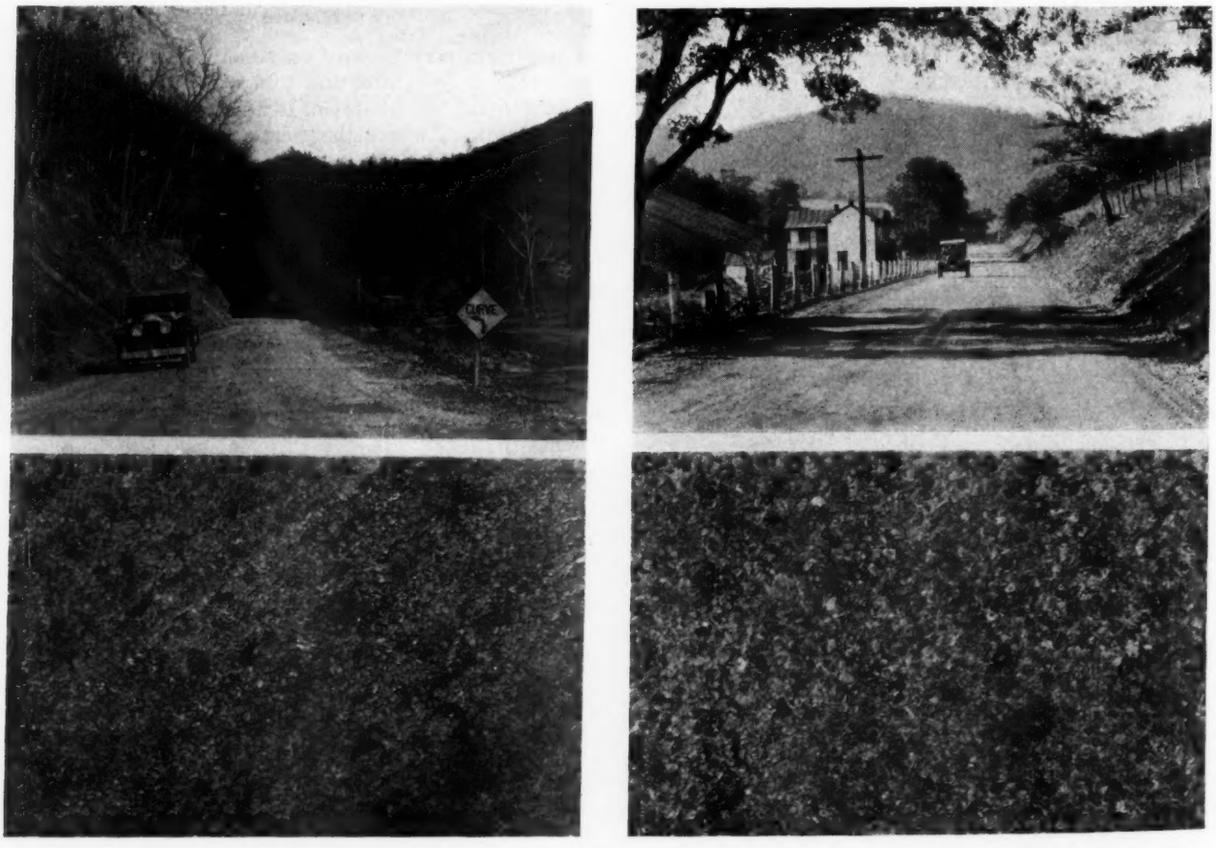
also for "evening up" rough pavements prior to initial surface treatment.

While the general policy in West Virginia is to grade a road a year or two in advance of paving, this has not always proven practicable, and on roads where paving has been carried on simultaneously with the grading, some settlements have occurred on the heavy fills or in low, swampy sections, which in places has resulted in a wavy and uneven surface. Prior to the first surface treatment of such surfaces, cold patching is carried on, checking with a straight edge, and continuing such patching until no further settlement occurs. Edge patching is concurrently carried on, widening all points where traffic tends to ride the shoulders. As fast as these patches pound down and settle, additional material is added until stability is obtained. By such edge patching, about a foot additional width of pavement is gained at each treatment. When the next surface treatment is made, the whole blends in together, and a smooth-riding and also a good looking surface is obtained.

The most essential characteristic of any road is smoothness, as this is the criterion of the public quality. With continued smoothness there of necessity is stability, and with a smooth surface there should be no need for surface treatments more often than every three years, (except under very heavy traffic), and with hot treatments even four years have elapsed between applications. As a general practice, however, and since cold bitumens have reached their stage of accurate development, we favor their use, with light treatments not to exceed one-quarter gallon per square yard about every three years. In some cases one-eighth to three-sixteenths gallon every two years may be desirable. Cold material has a greater stability after set-up and, when applied at a rate just sufficient to hold chips, resists shoving and waving of the surface.

(d) *Gravel.* In some states, difficulty has been met with in the surface treatment of gravels, but I believe that the whole reason for failure to achieve satisfactory results has been due to the use of an insufficient amount of bitumen. Gravels vary widely in grading and character, and the satisfactory rate of application has to be worked out for each particular character of gravel. Gravels in West Virginia vary from the coarse sandstone gravels found in the small creeks to the commercially sized gravel obtained from the Ohio and Potomac rivers; and the method of treatment varies according to this grading. These are all sandy gravels with practically no clay, being all taken from stream beds, and should not be confused with bank gravels which have a large amount of clay and require a different treatment. However, the degree of variation is simple and if the following method is followed, I do not believe that any difficulty will be experienced.

The general procedure is to allow the gravel to become well compacted under traffic, frequently blading the surface and adding new material until smooth and even. As soon as the surface has fairly well dried out in the spring, about the latter part of May or June, it is lightly swept with a rotary sweeper and a quar-



At Left: River Gravel Surface Treated With Three ¼ Gallon Applications of Cold Asphalt and Chips. Road Ten Years Old; One Year Since Last Treatment. Maintenance Has Consisted of Dragging, and Asphalt Treatment After Final Consolidation. At Right: Asphalt-Treated Shale Surface, Eight Years Old, on Route 54, W. Va.

ter gallon of cold material applied with the distributor.

No cover coat is put on this first application and it is nearly all absorbed by the road surface. Several days later a second quarter-gallon application is made and covered with 5/8-inch pea gravel or chips. With fine gravels, this second application will usually be enough for the first season. If it absorbs pretty well, however, or is pitted, a third quarter-gallon application is applied and again covered, and in some cases even the fourth quarter-gallon application is made and covered before a smooth, uniform surface is obtained. This gradual building-up process is desirable, because there is no way of predetermining just how much material will be absorbed by the surface, as is the case with a macadam surface. These light applications should be added until the desired appearance of the surface is obtained, whether it is one-half gallon, three-quarters or even a gallon, and no definite rule can be laid down. I wish to repeat that in my opinion practically all failures in surface treatment of sandy gravel have been due to inadequate amounts of bitumen, or else to an insufficient thickness of gravel to produce stabilty of surface. We have treated all kinds of gravel roads, from the extremely fine chert gravel up to the very coarse creek gravels, and all with uniform success.

Cold Patch Widening on Inside of Curve, Resulting From Three Years Maintenance Edge Patching. A Wider Road Secured by Intelligent Maintenance Expenditure

(e) *Shale.* Nearly every section of the country has a local material which has given success as a road surface material in one form or another. The particular material easily available in West Virginia is shale. There are, however, an infinite variety of shales, some absolutely worthless as surfacing materials, while others produce an appearance very similar to first-class water-bound macadam. An interesting development in the use of shale has been the making use of previously gained knowledge, to predetermine whether a proposed material will give satisfaction, and even information as to where to look for such material. From time to time, as shale has been used as a surfacing, chemical analyses have been made of each pit and at a later date comparisons made with service results, so that a fair index of the worth of a material is now possible from a knowledge of its chemical make-up.

In general, a shale must contain from 55 to 65 per cent silica, from 6 to 10 per cent ferrous oxide and from 3 to 5 per cent magnesium and calcium, to be a thoroughly stable material. If the clay content runs over 20 per cent, the material will break up badly during the winter. While these shales vary widely in their chemical analysis, yet the same kind of shale is usually found within the same geological horizon. Knowing, therefore, that a certain good shale can be obtained in a certain stratum, by reference to a good geological map of any area it can be predetermined fairly closely where to look for such material. By following out this practice, it has been possible to build some very excellent graded shale roads at low cost which are giving first-class service.

These roads are good summer and winter, but under fast-moving traffic become dusty during the dry season and somewhat slippery during rainy weather. To overcome this, surface treatments have been given and in some cases have progressed beyond the surface treatment stage to the building up of thin macadam wearing coats. The first application is a cold material

Asphalt Treatment Costs

TYPE	QUANTITY AND COST OF INITIAL SURFACE TREATMENT PER SQ. YD.	PERIOD BETWEEN TREATMENTS	ANNUAL MAINTENANCE PER. SQ. YD., INCLUDING PATCHING	TRAFFIC
WATER BOUND MACADAM	$.09 ½ Gallon	1 yr. to second 3 thereafter	$.04	500 to 1000
PUDDLE MACADAM	$.05 cold .10 hot ¼ Gallon	1 yr. to second, 3 thereafter	$.03	500 to 1000
PENETRATION MACADAM	$.05 cold .10 hot ¼ Gallon	3 years	$.03	500 to 1000
COLD PATCH & WIDENING	$6.00 per ton complete in place, including everything. Requires 12 gallons per ton with 1¼" chips, plus 8 gallons per ton with ⅜" chips to seal. Total, 20 gallons per ton of stone.			
GRAVEL	$.13 cold ¾ Gallon	Average every two years	$.10	200 to 800
SHALE	$.05 cold ½ Gallon	Annually	$.06	300 to 800

Hairpin Curve on Route U. S. 50 in West Virginia Illustrating Method of Surface Treatment Offering Least Inconvenience to Traffic. When the Treated Strips Have Set Up the Intermediate Ones Are Treated. Hairpin Curves Are Safest When Made at Least 50 Feet Wide

which should not exceed 70 per cent residual content. In May or early June the surface is lightly swept with a rotary sweeper and the cold material applied at the rate of about one-quarter gallon per square yard. With high-grade shales there is practically no absorption of the bituminous material (as is found with gravel), as the shale is very dense. Accordingly, it is necessary to apply cover to the first application, and this is done by carrying back the windrow of self-material that was swept off the road. This is done with a one-man grader. Places not covered with the grader are touched up by hand, taking additional cover coat from the edge of the road itself. Several days after the first application, a second quarter-gallon application is made, which as a general rule fills all open places left by the first application and produces a thin bituminous mat uniformly over the entire surface of the road. One-half gallon is usually sufficient in amount for the first season's treatment.

Roads so treated are extraordinarily smooth and easy riding, and far superior in such qualities to any other type of pavement. During the first winter, especially if there is much freezing and thawing, a considerable portion of the surface may break up and flake away, usually at those sections of the road where poor quality shale had been used or where drainage conditions had not been entirely corrected; rarely, however, exceeding 20 per cent of the total mileage. Accordingly, with the next season's treatment there is a certain carry-over, so that on long stretches only a quarter-gallon application is necessary to reproduce a smooth and uniform surface.

The great advantage of this method of treatment is the rapidity with which it can be carried on, as, using the one-man grader and the self-material, the item of cover coat is almost eliminated, which in macadam surface treatments often makes up one-half the cost of the work. These bitumen-treated shale roads have given entire satisfaction and over a large mileage are giving all the transportation service that could be obtained from the very highest type of construction. Such roads have carried as high as 1,000 vehicles per day, but average from 300 to 800 summer traffic and 200 to 400 winter traffic. Sometimes during the latter part of the season there will be places which will ravel, and it is desirable to go over the surface with a patching crew, touching up such ravelled places by merely sprinkling on the cold bitumen and covering with a shovelful of shale from the side of the road. The cost of such repair runs about $10 to $15 per mile.

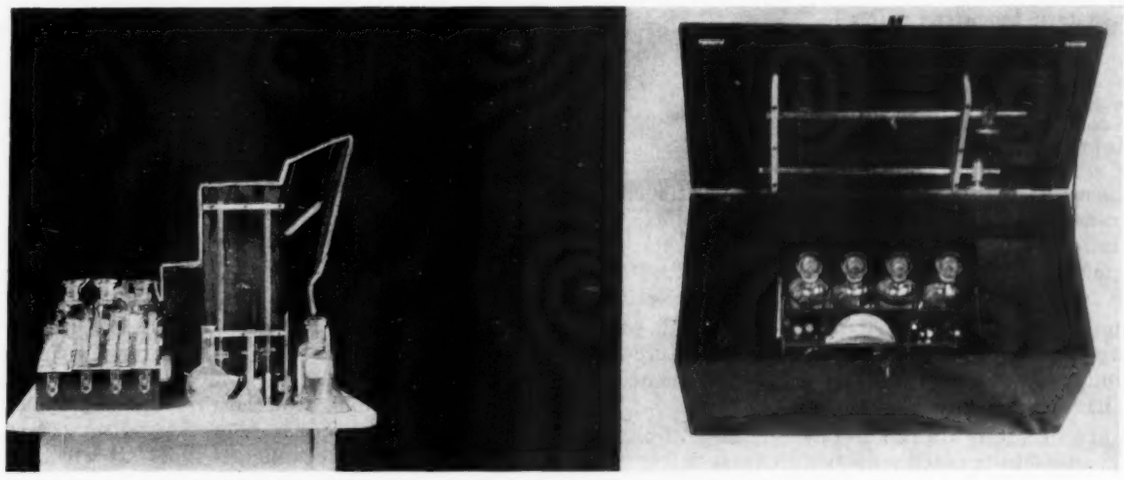
The Kalispell Municipal Airport

The Kalispell, Mont., municipal airport is located within five minutes' drive of the business section of the city. It contains 137 acres, 123 acres of which are level and are used for landing purposes. The property was purchased in the fall of 1928 at a total cost of $9,014.00, but nothing was done to put the property in shape until the spring of 1929, at which time the city and county began work. City forces removed all cross fences and built line fences; then the county came on the field with a heavy caterpillar, and with discs, harrows, levelers, etc., put the whole field in excellent condition. A runway, 100 feet wide and 3,000 feet long, was surveyed and the county graded it into shape. The city watered the runway, then rolled it, and a 30-foot strip, 2,600 feet long, was crushed, rocked, oiled and rolled, the county assisting with the rock hauling. The cost of the runway was $1,600.00, and it is said by aviators to be one of the best in the northwest.

In the center of the field a circle, 100 feet in diameter and five feet in width, was built of rock, crushed and whitewashed. This can be seen by ships in the air for many miles distant. The boundary of the landing field is determined from the air by thirty markers, six feet in diameter, and whitewashed, and located at intervals along the property lines.

A Bunday patent hangar, 50x85 feet, was constructed at a cost of $2,297.00. It is of sheet iron and has a capacity of two ships of 50-feet wing spread each. Entrance to each compartment is on opposite sides of the hangar and the building contains an office and storeroom. A rental charge is made, both monthly and daily, for ships using the hangar, and there is also a charge made for using the landing field.

The total cost of the airport is approximately $13,000.00. It is considered a good investment by the municipal officials and citizens.



LEFT: *Apparatus Set Up for Use;* RIGHT: *View Inside of Portable Laboratory Kit for Filter Plant Control*

Portable Laboratory Kit for Filter Plant Control

Developed by the Jefferson County Board of Health

An outfit has been devised which is easy to carry but contains all the essentials for checking on the operation of water purification plants.

By K. W. Grimley*

Jefferson County, Alabama, is unusual in that within its 1200 square miles of territory are concentrated 36 separate, independent public water supply systems. The majority of these are small, serving industrial villages of 5000 population or less; but for this very reason their control is an important aspect of local public health administration, because of the impossibility of providing technically trained operators for such small plants.

Of these supplies, 15 consist of rapid sand filtration plants treating more or less seriously contaminated surface waters. A description of some of these small plants appeared in PUBLIC WORKS for September, 1926.

In the summer of 1929, the Bureau of Sanitary Engineering of the Jefferson County Board of Health decided to institute a program of closer supervision over the operation of filter plants in the county. While still in the experimental stage, this program has already justified its adoption by the correction of several gross errors in plant operation.

The plan consists essentially of three parts: (1) The submission of regular weekly reports of all operating details, such as quantities of water filtered, chemicals used, and wash water used; alkalinities of raw and filtered water, etc.; these being sent by the filter plant operator to the bureau on forms provided by the latter; (2) the collection of monthly samples of raw, filtered, and distributed water from each plant for bacterial analysis in the laboratories of the Board of Health; and (3) a complete inspection, including chemical investigation of the raw and treated water, of each filter plant, to be made monthly by an engineer from the bureau.

As many of the smaller plants are not equipped for maintaining laboratory control of operation, it has been necessary to design and construct a portable "laboratory" for making the needed chemical tests; namely: (1) alkalinity—total, carbonate, bicarbonate, and caustic; (2) approximate hardness—total, carbonate, and non-carbonate; (3) pH; (4) free CO_2; (5) residual chlorine, and (6) residual aluminum sulphate.

The necessary apparatus has been assembled in a specially constructed wooden box 10 inches by 10 inches by 21 inches and weighing complete 25 pounds.

The apparatus included consists of:

2	10 cc	burettes
2	100 cc	porcelain dishes
5	4 oz	regent bottles (1 empty)
1		large funnel
1		small funnel
1	50 cc	measuring flask
1	250 cc	flask
1		stirring rod
2	10 cc	vials
1		medicine dropper
2		indicator bottles (dropping)
		filter paper
1		LaMotte-Enslow chlorine comparator
1		LaMotte pH set, bromcresol purple
1		LaMotte pH set, bromthymol blue
1		LaMotte pH set, phenol red

together with the following reagents:
N/50 sulphuric acid
N/22 sodium carbonate
Standard soap solution

*Assistant Sanitary Engineer, Jefferson County Board of Health.

Phenolphthalein indicator
Methyl orange indicator
pH indicators: bromcresol purple
bromthymol blue
phenol red
Ortho-Tolidine
Acetic acid (Glacial)
Haematoxylin solution
Distilled water

This method of packing has proven very satisfactory for transportation by hand and by automobile. The case is reasonably light, considering its contents; and the glassware is secure against breakage in spite of rough roads.

The burettes are carried on a wooden stand, which during transportation is attached by thumbscrew to the underside of the cover; and during use, bolted in a similar manner to one end of the box.

In practice, tests are run on raw, settled, and filtered water; and results noted on a special form sheet. The inspection also includes a checking of rates of filtration and wash, and a general survey of conditions.

This program of supervision has in several instances revealed startling conditions at some small plants; and also disclosed the inadequacy of relying entirely upon results of bacteriological analyses, even from samples collected at frequent intervals. For example, at one plant, treating a raw water containing less than 10 ppm total alkalinity, the operator was using as the sole chemical treatment a dosage of over 15 grains per gallon of aluminum sulphate! At another small plant, the part-time operator, running out of coagulant, and remembering that he had heard it referred to (by someone who should have known better) as "alum," had gone to a drug company and purchased "alum." This chemical was used for several weeks, until the bitter taste and astringent properties of the treated water led to numerous complaints and a visit by the "travelling laboratory."

The "build and be gone" practice referred to in previous issues of PUBLIC WORKS is particularly vicious when applied to a water purification system. Manufacturers' claims to the contrary notwithstanding, no small filter plant is "completely automatic," no matter how elaborately equipped with electric float switches. Here also the human factor is a weak link which can only be strengthened by a periodic inspection of *all* the processes of treatment and their results, by some competent agency.

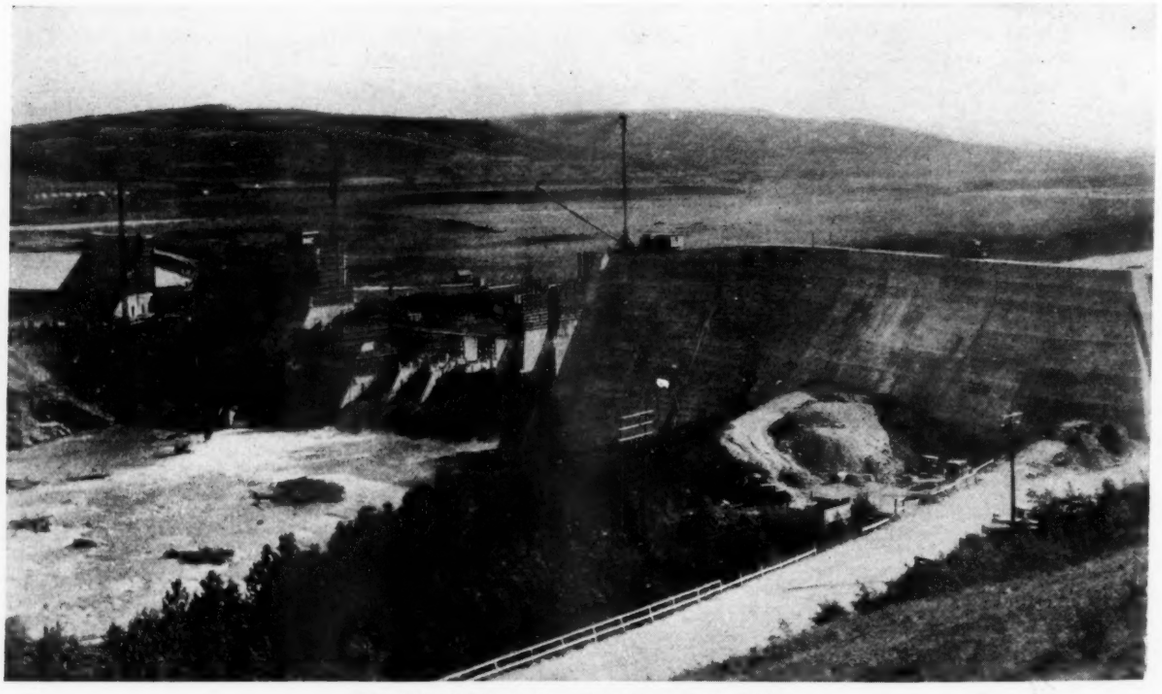
Constructing the Ghost River Dam

Construction work on the Ghost River Dam, which is located on the Bow River, in Alberta, Canada, just below the confluence of the Ghost river, is now about completed. The dam, which is three-quarters of a mile in length and 110 feet in height, is of the composite concrete and earth embankment type. It will back up the waters of the Bow river for nearly 9 miles, and the lake thus formed will have an area of over 3,000 acres. About 36,000 horse-power will be generated at the dam. The lake itself will be developed as a pleasure resort.

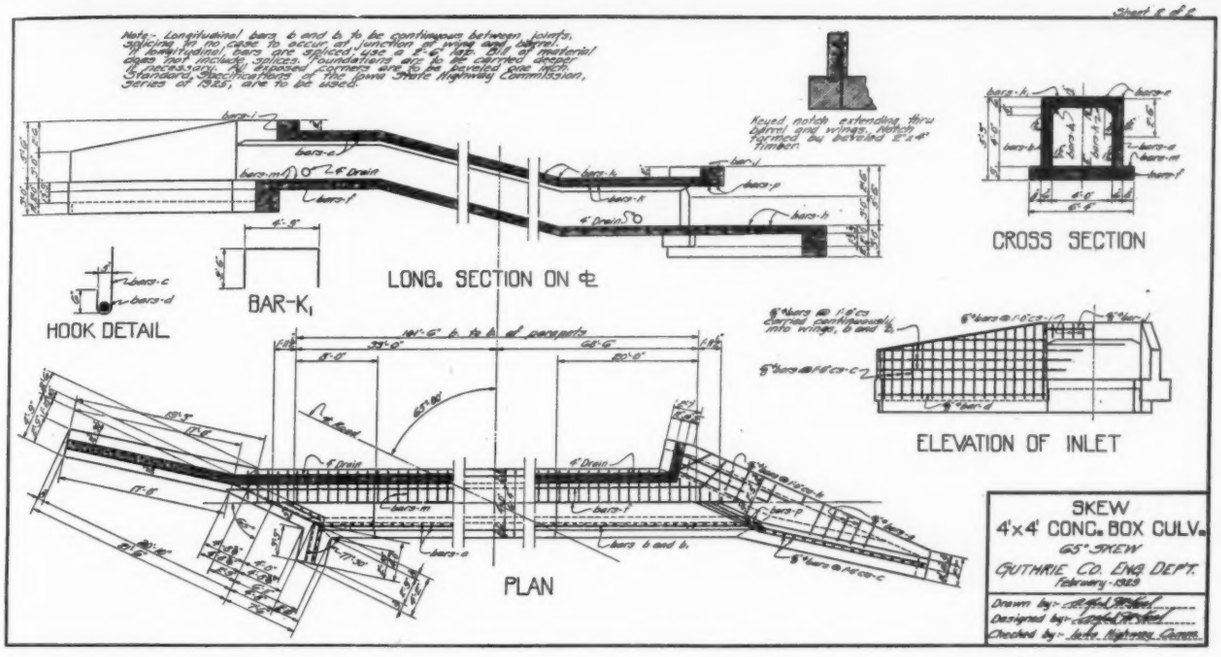
The earth and rock fill required for the embankment section of the dam amounts to 800,000 cubic yards. Deposits of suitable earth were found near at hand, and were handled by power shovels, and loaded into trucks which hauled to the dam. The concrete section is of the gravity type; it is provided with an inspection tunnel running its entire length. Six 20-foot sluiceways will control the flow of water through the dam. About 75,000 cubic yards of masonry were required for the concrete section.

Between 500 and 600 men have been employed on the dam.

A new highway bridge, 600 feet long and 97 feet above the river, forms part of the project.



The Ghost River Dam Under Construction



The Design of Reinforced Concrete Culverts

By Alfred McKeel
County Engineer, Guthrie County, Iowa

There are six fundamental factors that must be observed and followed closely in designing reinforced concrete box culverts, if these are to be built for permanence.

First.—The culvert must be fitted into the natural topographic conditions encountered. I have found, over a period of fifteen years, that if this procedure is followed no trouble is experienced in later years with the culvert undermining or washing out. Never build the culvert disregarding natural conditions and try to create artificial conditions to conform with the culvert. This is particularly true in hilly country. Fitting a culvert into natural topography calls upon the ingenuity of the engineer. For instance, conditions may call for a skew barrel, flaring wings, straight and flaring wings, drop inlets, broken backs in barrels or special wing designs or barrel designs.

Second.—The water area of a culvert must be correct. This, of course, is controlled by the watershed area and the classification of the topography. Economic reasons necessitate building a box culvert as small as other conditions will permit. For instance, if 20 square feet of water area will handle the flow of water, 24 square feet would not be an economical size. For this reason great care must be taken when surveying the watershed and classifying the topography. One great fault in the past has been in designing box culverts too small. Care must be used to design them large enough, but not too large. The writer makes considerable use of Talbot's formula in designing the water area of culvert. In this formula, "C" is the coefficient used by U. S. Office of Public Roads.

Third.—Culverts must be the right length and designed to carry a specified fill. The length is controlled by the width of the roadbed and the amount of fill over the culvert. Also the amount of skew, in a skew culvert, affects the length. The amount of traffic controls the width of the roadbed. Our minimum width is 24 feet and we have roadbeds as wide as 30 feet. We use a slope of 1½ horizontal to 1 vertical on all earth fills. When we find it necessary or advisable to build a permanent box culvert on an ungraded road, we always lay a permanent gradeline on the road and design the culvert for the resulting grade. Even though it may be several years before this particular road is permanently graded, the culvert will be completed and ready when the time comes.

Fourth.—The elevation of the inlet and outlet must be correct. This is very important. We spend large sums of money each year on supposedly permanent culverts, on which the designers disregarded this point. Failure to consider this item results, in some cases, in the culvert washing out at the outlet, undermining the headwalls and part of barrel breaking off. In other cases, it results in the outlet filling, thus cutting down the water area of a culvert. I have seen cases where the culvert was completely filled. Either of the above cases are failures, necessitating the expenditure of large sums of money to remedy. Usually the remedy is not permanent.

When considering this fourth factor, serious study must be given to whether a certain location is filling or cutting. One should study the nature of the soil with this in mind. We always make borings on the site of the culvert to determine the foundation material. After considering these items, the elevation of the outlet should be determined accordingly. The elevation of the inlet, although not as important as

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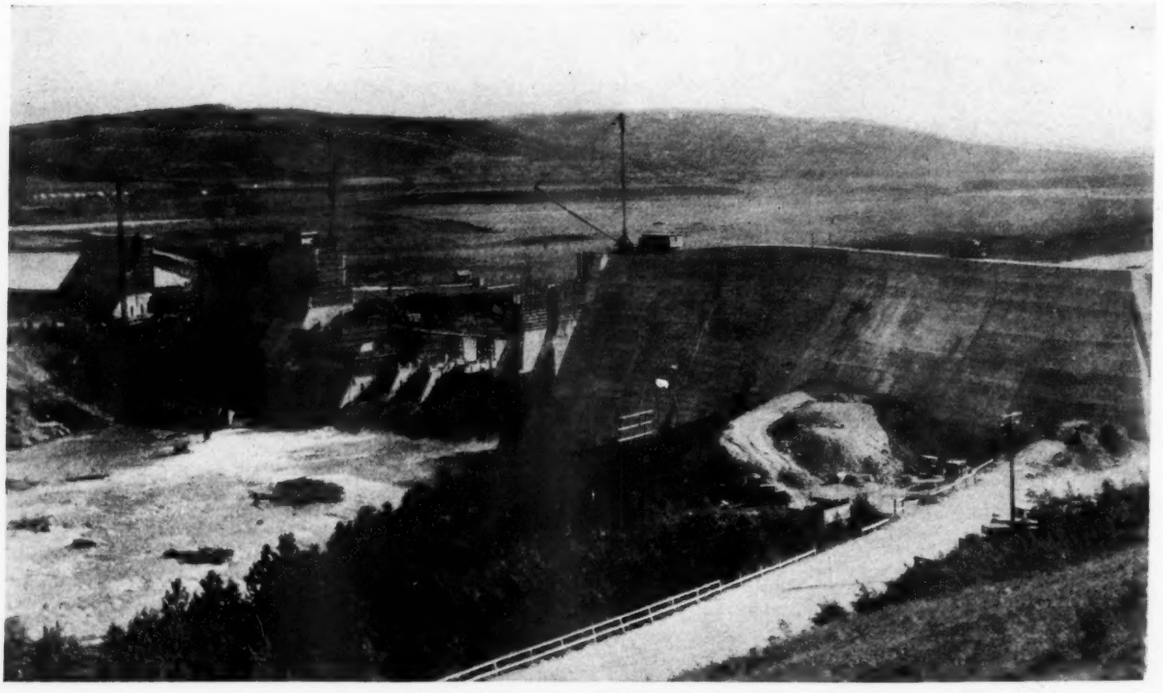

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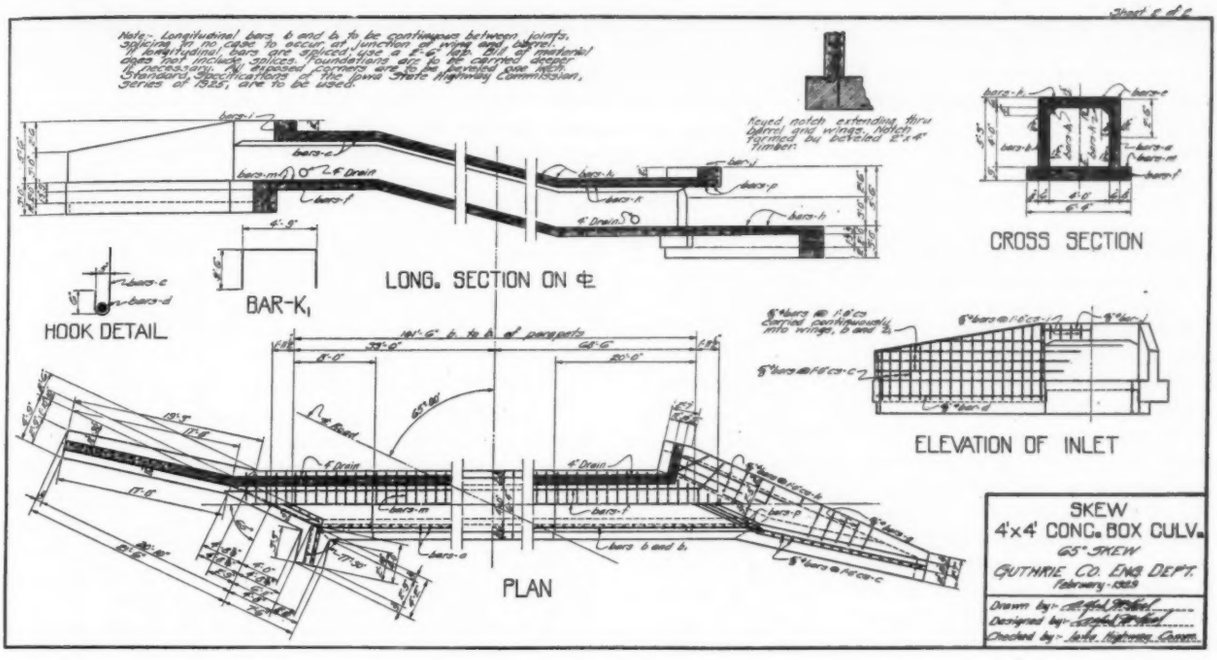
Note:- Longitudinal bars b and b' to be continuous between joints. Splicing in no case to occur at junction of wing and barrel. If longitudinal bars are spliced, use a 6'-6" lap. Bill of materials does not include splices. Foundations are to be carried deeper if necessary. All disposed currents are to be handled over with Standard Specifications of the Iowa State Highway Commission, Series of 1925, are to be used.
keyed notch extending thru barrel and wings. Notch formed by beveled 2"x4" Timber.
LONG. SECTION ON ℄
CROSS SECTION
BAR-K1
HOOK DETAIL
ELEVATION OF INLET
PLAN
SKEW
4'x4' CONC. BOX CULV.
65° SKEW
GUTHRIE CO. ENG DEPT.

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When considering this fourth factor, serious study must be given to whether a certain location is filling or cutting. One should study the nature of the soil with this in mind. We always make borings on the site of the culvert to determine the foundation material. After considering these items, the elevation of the outlet should be determined accordingly. The elevation of the inlet, although not as important as

the outlet, should also be considered seriously. Frequently the use of a drop inlet, or catch basin, will cause to fill an otherwise deep ditch on the upstream side of the road. If these catch basins are designed with care, they do not in any way affect the proper functioning of the culvert and usually accomplish a great amount of good to the road.

The writer has designed and built several hundred box culverts in the past 15 years and by carefully studying this fourth factor he has experienced no difficulty in after years with culverts either washing out or filling up. The writer has also designed and built innumerable drop inlets, some as large as 100 square feet water area, that are working perfectly.

Fifth.—The materials that go into a culvert must be good and meet certain specifications. We have always made use of the Standard Specifications of the Iowa State Highway Commission for such materials. This includes sand, gravel, cement and reinforced steel. All of these materials are tested regularly by the State Highway Commission Laboratories located in different parts of the state before shipment is made to the consumer. Unfit material is rejected before shipment is made. On all material shipped, a report of same is sent from the laboratories to the engineer in charge of the work. In this manner we have a check on all material used in building the reinforced concrete box culverts. Guthrie County has some deposits of good, clean, coarse, concrete aggregate and the use of this is permitted after tests indicate that it meets the above specifications.

Sixth.—A culvert must be back-filled properly. Considerable trouble has been experienced by us with culverts where this factor has been overlooked. In some cases, we found that logs, rocks and such materials, used in filling the culvert permitted water to work its way along the barrel, thus eventually eating out the fill. In other cases the fill was not tamped properly. Excessive settlement rendered the road dangerous to the travelling public. The fill should be composed of nothing but good, dense earth and should be tamped all along the barrel and behind the headwalls. Especially is this true on catchbasin culverts. Here water is likely to stand at the inlet end of culvert for some time before the ditch is filled to the flow line of the drop inlet, soaking into the grade, thus finding any weak spots and taking advantage of them.

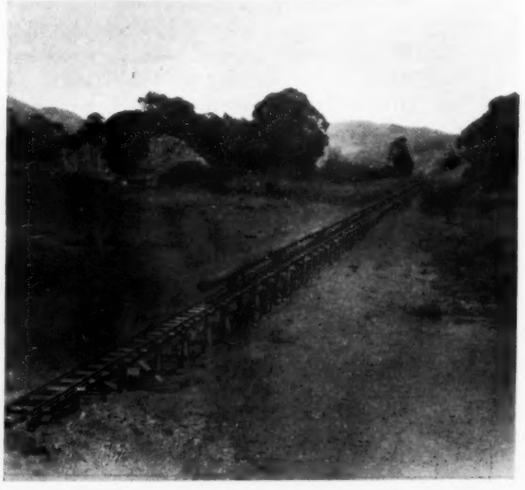
A set of skew culvert plans designed by the writer and shown herewith show the roof and floor of the box are designed the same as ordinary slabs. The weight of the fill and size of the box, of course, control the thickness of the roof, floor and sidewalls. A complete set of culvert plans as turned out by this office shows the following data: Proposed grade elevation, present grade elevation, elevation of inlet, and outlet. Longitudinal section and plan. Length of barrel on each side of centerline of road. Details of floor, roof, sidewalls, wingwalls, etc. Table of reinforcing steel and concrete quantities. General plan and location. Bridge number and miscellaneous data helpful to the bidder and builder. A profile of the present ground line is shown at site of culvert, with elevations. This enables the bidder to figure his excavation from the plans.

Submarine Pipe Line Constructed on Shore

Oil from the Kettleman Hills is conveyed to Estero Bay on the Pacific Coast through a 70-mile pipe line recently completed by the Standard Oil Company of California. This line, which is of 10-in. pipe, is completely welded and carries oil under an initial pressure of 1,000 lb. per sq. in. to storage tanks on the coast, no booster-stations being used.

Since a deep water harbor is not available at this point, a 16-in. submarine pipe line has been constructed to carry the oil from the storage tanks on shore out to the tanker anchorage 3,000 ft. at sea. At this point the oil is loaded for transport to the refineries by means of a hose attached to the seaward end of the pipe and connected to a buoy by a chain. This submarine line was entirely welded by the oxy-acetylene process, the standard open vee butt weld being used without straps or any reinforcements.

One of the most interesting features of this line is that it was entirely constructed on shore, a narrow-gauge railroad extending 3,000 ft. inland in a straight line on a 2 per cent grade, having been constructed especially for the purpose. All welding was done at the inland end of the track, and as fast as lengths of pipe were added to the line at this point it was moved forward toward the shore on trucks running on the narrow-gauge tracks. The illustration shows the complete portion of the line on its way toward the sea. When completed the end of the line was capped, equipped with a sled and towing bridle and pulled out to sea by means of a tug. A hydrostatic test showed that the welded line had withstood the launching operation perfectly and was ready for service.



The Narrow-Gauge Track With Pipe in Place Ready for Launching

State Organization of Sanitary Engineering

An historical review of the development of state sanitary engineering departments is presented.

By James A. Tobey, Dr. P. H.

Public health has many ramifications but it would be somewhat barren without the services of the engineer. Sanitary or public health engineering has long been recognized as one of the essential features of effective state health administration, and today one or more engineers are employed by the state health departments of all but three of our states. In all but one instance these state sanitary engineers are on a full-time basis.

Progress in public health engineering by the states has been rapid during the last few years, though it has by no means attained its highest general efficiency. Ten years ago, 38 states and territorial health organizations maintained bureaus of sanitary engineering, while twenty years ago there were only 11, and in 1900 only two such important divisions were in existence. Great impetus was given to this development during and immediately after the World War, so that 14 such bureaus were created in the period between 1916 and 1920.

Massachusetts, leader in many public health measures, was the first state to establish an engineering department under its state board of health. Massachusetts had been the pioneer in this country in setting up a state health board, which was created in 1869, following somewhat tardily the classic sanitary survey and report of Lemuel Shattuck, published in 1850. In 1884 the state Board of Health, which had formerly been concerned with charity and "lunacy," as well as with public health, was reorganized as a strictly sanitary department. A prominent civil engineer, Hiram F. Mills, became a member of the board, an office which he held for the next thirty years. In 1886 the division of engineering was established and has been an integral part of the department ever since, though the name was changed to the Division of Sanitary Engineering in 1914, when the department was again reorganized.[1]

Many notable contributions to the engineering aspects of public health emanated from Massachusetts during the first decade of the existence of this engineering department. It was, in fact, the sole occupant of this field for a dozen years, for the second state division of sanitary engineering was not created until 1898, when Ohio followed the lead of Massachusetts and placed such a bureau under its state board of health.

An act to protect the purity of inland waters had been adopted by the Massachusetts Legislature in 1886 and the first duties of the engineering division were to carry out its provisions. In 1887 chemical analyses were begun by Dr. Thomas M. Drown of the Massachusetts Institute of Technology and in the following year Professor William T. Sedgwick of the Institute was appointed consulting biologist to the board. A sewer experiment station was placed at Lawrence, Mass., and was in active operation until 1895. The results of this research were, as the late Professor George C. Whipple has phrased it, "probably. . . as valuable as the results of all other American sewage experiment stations put together." Many engineers and scientists already eminent, or who later became distinguished, were connected with this famous station. The experiment was a noteworthy demonstration of the wisdom of investing the state's money in men and brains.

With the turn of the century, sanitary engineering divisions began to appear in the state health departments. Over in the Philippines, such a bureau was created in 1901, while Pennsylvania and New York established engineering activities in 1905, Indiana in 1907, and Virginia and Minnesota in 1910. The dates of establishment of bureaus of sanitary engineering throughout the country are shown in the table, compiled from information gathered by R. E. Tarbett, chief of the Engineering Section of the United States Public Health Service, which employed its first sanitary engineers in 1913.

When Dr. Charles V. Chapin made his comprehensive survey of state public health work in 1914, under the auspices of the American Medical Association, he reported that only about a third of the states then appeared to be taking an active interest in the protection of water supplies, which he characterized as peculiarly a state responsibility. At that time 18 states had engineers or bureaus of sanitary engineering, the most extensive organization being in Pennsylvania, where there were said to be a chief and about twenty engineers, as many clerks, a number of draftsmen, and 55 inspectors. The supervision of water and sewerage works was the principal activity of all the engineering divisions of those days, though a few dealt with ice, garbage, the sanitation of public buildings, shellfish control, and nuisances.

Contrast these conditions with those found in 1925 in a remarkable study of state and provincial health departments conducted by the International Health Division of the Rockefeller Foundation for the Conference of State and Provincial Health Authorities of North America.[2] At that time only five states were without the services of a sanitary engineer, and two of these, Arizona and Oregon, have subsequently provided for such work. In 1925 appropriations to the state bureaus of sanitary engineering varied from a low of $2400 a year in South Dakota to a high of $145,000 annually in Pennsylvania. The percentage devoted to engineering out of the total state health budgets varied from 2.6 per cent in Oklahoma to 22.6 per cent in Iowa.

Among the activities undertaken by state bureaus of sanitary engineering in 1925 and also at present are the control of water supplies; the enforcement of the proper disposal of sewage and industrial wastes; the prevention of pollution of harbors, lakes, streams, and other inland waters; the control of shellfish; the prevention of malaria through mosquito extermination;

the safe-guarding of milk supplies; the supervision of housing; the sanitation of camps, bathing beaches, and swimming pools; and all other matters concerned with environmental sanitation.

In all but eight of the states, bureaus or divisions of engineering or sanitation are now maintained. In five others, the engineering work is so organized that it is combined with the laboratory or chemical activities, or as a division of water and sewage only. A few states, such as Massachusetts and Kansas, have distinct divisions of water and sewage in addition to their sanitary engineers. One or two also have divisions of plumbing inspection, an archaic system for a modern health organization. In 1925, fifteen states were reported as having sanitary engineering laboratories.

Formation of Sanitary Engineering Divisions in the Various State Health Departments

1886 Massachusetts.
1898 Ohio.
1901 Philippine Islands.
1905 New York.
1907 Indiana. Originally a water and sewage department, changed to sanitary engineering in 1928.
1907 Kansas. An engineer from the State University carried on water and sewage work from 1907 to 1915, when a division was organized under the state board of health.
1909 New Jersey. This state had a State Sewage Commission as early as 1899. It was transferred to the State Board of Health in 1908, and a Division of Water and Sewage was set up in 1909. This became the bureau of engineering in 1915.
1910 Virginia.
1910 Minnesota.
1911 Porto Rico.
1911 Montana.
1911 North Carolina. Originally a bureau of engineering and education. The bureau of sanitary engineering and inspection was established in 1919.
1912 Maryland. This bureau was authorized by the Legislature in 1910, but was not created until 1912.
1913 Hawaii.
1913 Louisiana.
1913 Michigan.
1913 Iowa. This state had a part time engineer, 1910-1913.
1914 Alabama.
1914 Rhode Island. This state had as early as 1900 a chemist who also acted as sanitary engineer of the board of health.
1915 California.
1915 Texas.
1915 Illinois.
1915 West Virginia.
1916 Florida.
1917 Connecticut. Prior to 1917 engineering work was performed by the engineering member of the board.
1917 Maine.
1918 Oklahoma.
1919 Arizona. From 1913 to 1919 milk and water inspection was undertaken by an engineer.
1919 Kentucky. This state also had a full time engineer during the one year 1911.
1919 Arkansas.
1919 New Mexico.
1919 Vermont. On a part time basis to date.
1919 Wisconsin.
1919 South Carolina.
1919 Washington.
1920 Georgia.
1920 Mississippi.
1920 New Hampshire. Prior to 1920 engineering work was performed by the engineering member of the board. As early as 1901, engineering was also done under the auspices of the Laboratory of Hygiene.
1921 South Dakota.
1921 Tennessee.
1922 Utah.
1922 Missouri.
1924 Delaware.
1925 Idaho.
1925 Colorado.
1926 Oregon
1928 North Dakota.

Nebraska, Nevada, and Wyoming do not have engineers in their state health departments.

Engineers have made many brilliant contributions to the modern science of public health. The late Dr. Victor C. Vaughan stated, a number of years ago, that as an all-around man the sanitary engineer was more efficient as an epidemiologist than the physician, and that some of our best municipal health officers were engineers. Dr. William H. Welch has also pointed out that the claim that engineers make competent sanitarians and health officials has been borne out by their brilliant achievements in this field. [3]

In his annual message to Congress on December 3, 1929, President Herbert Hoover, who not only is an engineer himself but has been intimately connected with the child health movement for many years, stressed the importance of the engineer in public health when he said that, "where highly developed, a health unit comprises at least a physician, a sanitary engineer, and a community nurse, with the addition, in some cases, of another nurse devoted to the problems of maternity and children."

Since 1899 about 1000 persons have graduated as sanitary engineers from colleges and universities in this country. At present six institutions offer specific degrees in sanitary engineering, though ten others give optional courses, usually in conjunction with their departments of civil engineering. In 1928 there were 66 graduates in sanitary engineering, the largest number since 1918. The pioneer course was that established at Columbia University in 1886, with the Massachusetts Institute of Technology a close second in 1889, and Illinois following in 1890.[4]

Sanitary or public health engineering will undoubtedly increase in scope as one of the important functions of state health work. Environmental sanitation will always be a significant matter, even though its past achievements have been effective in the virtual eradication or reduction of many diseases, typhoid fever, for example, which formerly took a tremendous toll of human lives. Eternal vigilance is, however, the watchword in public health, and the field for the engineer in this science is an increasing rather than a decreasing one.

(1) Tobey, J. A.: Public Health Administration in Massachusetts. Boston Medical and Surgical Journal, Aug. 18, 1927.
(2) Issued by the United States Public Health Service as Public Health Bulletin No. 184, 1929.
(3) See Tobey, J. A.: Some of the Engineering Aspects of Public Health. Engineering News-Record, April 21, 1921.
(4) Mendelsohn, I. W.: in Public Health Reports, March 22, 1929.

Street Oiling in Kalispell, Mont.

In 1929 there were used on the streets of Kalispell, Mont., 86,942 gallons of asphaltic road oil, 34,937 gallons of light oil, 9,937 gallons of Roadamite (94 plus asphalt) and 15,520 gallons of Bitumuls (emulsified asphalt), the latter two being used on Main Street and on the depot project. In connection with the oiling and paving, there were used 4,335 cubic yards of sand, pea gravel, rock chips and rock dust, and at the crushing plant 6,855 yards of the various grades of material were manufactured.

Bituminous Surface Treatments in North Dakota*

Methods of oiling to give a waterproof surfacing. The penetration method. The mixed-in-place method. The plant-mix method. Maintenance. Kinds of Oil Used.

By J. N. Roherty†

The bituminous surface treatment used most in North Dakota is sub-grade oiling on the heavy clay soils, found chiefly in the Red River valley, for the purpose of forming a coating which will shed surface moisture and thus give a more stable roadbed. The soil of the Red River valley becomes very sticky when wet and deeply rutted; while when dry it is very hard and will carry heavy loads without yielding. The problem of the road builder is to keep the water out of these heavy clay soils.

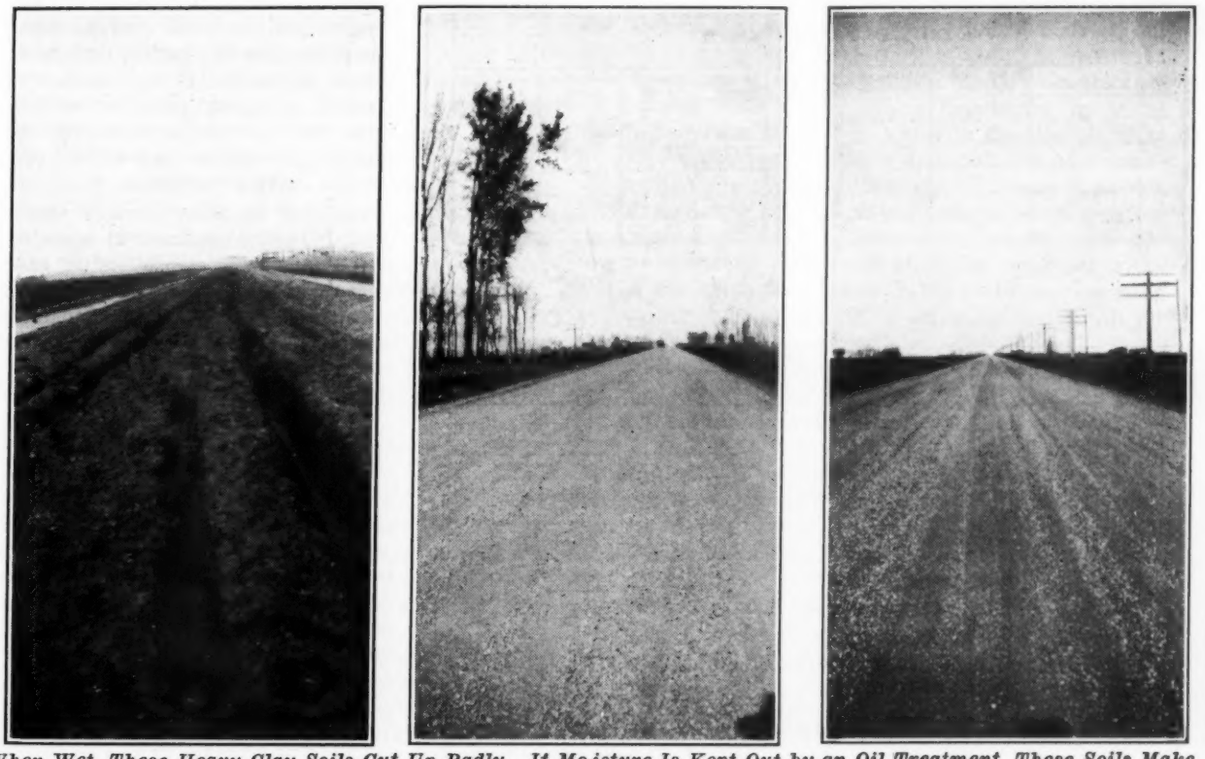
If the highway is built sufficiently high and wide so that the water that frequently stands in the side ditches does not soak too far into the roadbed, and the surface moisture is kept out by an application of oil, a poor roadbed material is transformed into a very good material. In many cases it is not practicable to obtain good, deep drainage ditches at reasonable cost, and high and wide grades are then the best solution for keeping the water from soaking under the roadbed.

The oil used for this purpose in North Dakota contains 60% to 70% of asphaltic residue of 100 penetration and has a viscosity of 10 to 25 Engler at 60° C. Such an oil spreads easily at a fairly low temperature (usually 175° F.) and penetrates fairly well into the clay, usually about ¼". The oil is put on in two applications as a rule, although sometimes more than one penetration coat is required to thoroughly saturate the clay. After the clay has absorbed all of the oil that it will take, about 0.35 gallon of oil per square yard is applied and is immediately covered with a blotter coating of gravel, about 400 cubic yards per mile of 24-foot roadway being used. A light mulch of fine, loose gravel should be maintained to minimize wear on the oil-gravel layer which serves to shed the surface moisture.

The first year's treatment requires from 10,000 to 13,000 gallons of oil per mile of 24-foot top, and approximately 400 cubic yards of gravel. From ⅓ to ½ gallon of oil per square yard is required the second and third years, together with from 100 to 150 cubic yards of new gravel. By that time all weak places should have been discovered and remedied and the

*Condensed from the "Highway Bulletin" of the Dept. of State Highways. Illustrations furnished through the courtesy of Mr. Roherty.

†Engineer of research and design, North Dakota Dept. of State Highways.



When Wet, These Heavy Clay Soils Cut Up Badly. If Moisture Is Kept Out by an Oil Treatment, These Soils Make a Good Roadbed Material

roadway stabilized sufficiently to be ready for a higher type of surfacing.

In the opinion of the writer, the greatly increased stability of heavy clays secured by a thorough surface treatment with oil justifies such treatment, no matter what type of surfacing or pavement is to be placed on it. I believe that no equal amount of load-carrying ability can be built into a road for an equal amount of money in any other way. As engineers, we should aim to get the greatest efficiency out of all the materials that enter into construction of our highways, and in too many cases the great possibility of stabilizing the clay sub-grade has been ignored. In North Dakota, where heavy macadam or gravel sub-bases cannot be obtained at reasonable cost, the results of subgrade oiling has been very gratifying.

SURFACE TREATMENT

In addition to sub-grade oiling, we also use bitumunious surface treatment to conserve gravel material, eliminate dust, and give a smoother riding surface.

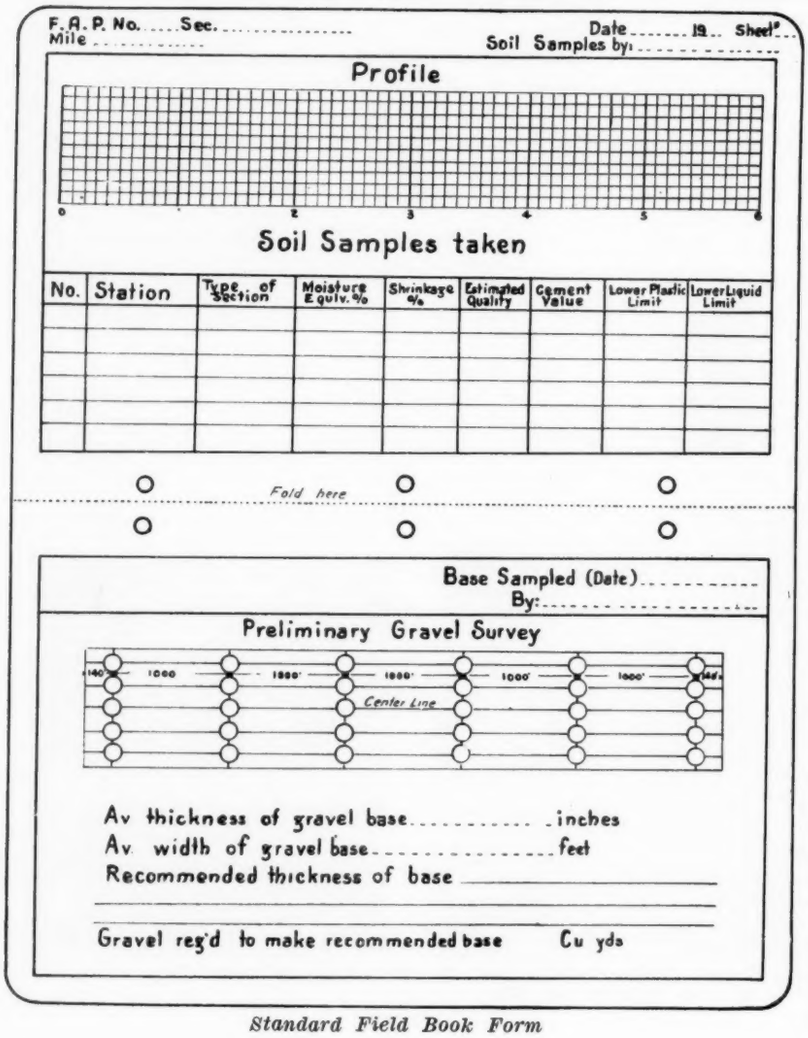
The essential requirements of a roadway to receive a surface treatment of this type is that the roadbed must be stable. A surface treatment is not a remedy for a poor piece of road but should be looked upon as a protective coating to be placed on a roadbed which is wide enough, high enough and strong enough to carry the traffic that it is called upon to serve. There is no supporting power in a thin surface mat of bitumen and gravel. A low, spongy or wet subgrade will not be improved by placing a bituminous surface over it, and where surface treatments have been applied on improper subgrades they have failed. This means that before some of our older and more heavily travelled roads can be given a successful surface treatment, they must be rebuilt.

Little thought was given in our first design to snow prevention; in fact, we even had requests that our grade lines be not built up so that the snow would be blown off them, as the farmers wanted a sleigh road for winter. But today traffic demands that the highway department maintain the roads clear of snow the winter through. It is expensive and almost impossible to keep these old low roads open, as they block with the smallest drift of snow and the ditches in many cases have nearly disappeared and have no capacity for snow. For minimizing snow trouble and cost of snow removal, as well as to secure a substantial roadway on which to place higher types of surfaces, we find reconstruction advisable on our older, more heavily travelled roads. The mileage of such roads is not great but they carry a large percentage of our total traffic and are found where snow removal is most badly needed.

A road is as much of an engineering structure as a building or a bridge, and the foundation deserves the same careful consideration that is given bridge and building foundations. It is possible to build a pavement slab so strong that the foundation can be slighted, but this practice is very questionable, especially in localities where surfacing materials are expensive and so much can be done cheaply to improve foundation soils. Where a roadbed is well built and drained, maximum value is obtained from the soil and a minimum of rock or gravel base is required under the surface treatment.

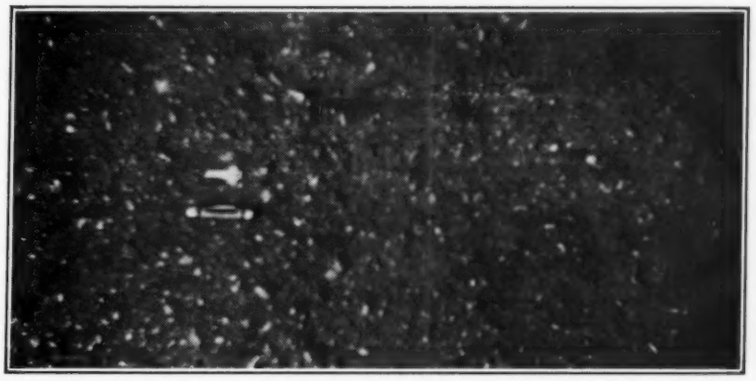
We find so-called surface treatment being constructed in some of our older states which would cost more to construct in our state than a concrete pavement. It is not uncommon to find bituminous retreads being built where from 8 to 18 inches of crushed rock is used as a base, the retread surfaces being a mixture 3 or 4 inches thick of properly graded crushed rock and a suitable bitumen. In those localities crushed rock is comparatively cheap, and plenty of it makes a good base; but we must accomplish the same result by a proper stabilizing of our soils and the use of light gravel bases, and our experience to date indicates that this can be done.

In our first surface treatments too little preliminary examination was made of the roadway, and the ones on poor bases were not satisfactory, but those on good bases have been



Standard Field Book Form

satisfactory. We have now standardized our practice in the matter of preliminary surveys and records. The standard field book forms are shown in the accompanying illustrations. The information obtained and recorded on these forms gives a clear indication of what is required if success is to be expected. Our base requirements are based on the nature of the soil, the drainage and the traffic to be carried. The "estimated quality" is classed as either "good," "fair" or "poor," using the triangle diagram as shown by A. C. Rose in his article in the August, 1924, issue of "Public Roads," influenced also by other factors mentioned above.



A Close-Up View Showing the Surface Texture. Observe Pocketknife and Key

Penetration Method

On a well drained soil which would be classed good, a successful first treatment with tar (a heavy or cutback also may be used) can be obtained on a well compacted gravel base of 3 inches. The method of application is as follows:

The roadway, having been trued up by intensive maintenance prior to treatment, is bladed as clean as possible and the loose material left in a windrow on the shoulder. Unless there is considerable dust or shallow depression, brooming is not necessary. The tar (about 15 specific viscosity Engler) is applied at the rate of about 0.4 gallon per square yard at a temperature of about 140° F. After the first application has penetrated thoroughly, a second application of approximately 0.3 gallon is spread and immediately covered with gravel by means of a power grader, about 350 cubic yards per mile of new gravel having been provided in a windrow along the shoulder for this purpose. Traffic is then allowed to travel on the covered portion of the roadway and the second half of the road is treated in the same way.

Light continuous grading for a few days evens the tar and gravel and smooths out depressions in the roadway. The surface sets up quickly and gives a smooth riding, dustless surface. Only slight depressions can be eliminated at the time the bitumen is applied, and the shape of the finished roadway will continue to be the shape of the gravel surface upon which is was applied; hence the necessity of taking pains with the maintenance prior to the treatment.

Some weak places will appear soon after the treatment and should be patched by hand immediately. If this is done vigilantly, a very satisfactory surface will result; but if it is neglected, these weak places will grow larger and not only make the job appear ragged but will also increase the ultimate cost of repairing them.

The thickness of a bituminous surface constructed in this way is about ¾ inch. This treatment must be repeated on succeeding years in order to build up a bituminous top of greater thickness. If a stable base was present under the original treatment, these layer-built wearing courses may be built up to several inches in thickness and will carry satisfactorily several thousand vehicles per day; the stability of the base is the secret of success as much as or more than the bituminous top.

Mixed-in-Place Method.—For the mixed-in-place type of surfacing, all new gravel material is used, although if the gravel base is of adequate thickness, gravel for the mix could be scarified up from the base. Our gravel bases have been constructed from pit-run gravel and are not sufficiently uniform to use satisfactorily for an oil-mix surfacing. One thousand cubic yards of new gravel is used for a mile of 20-foot width top. This gives just a little over two inches of compacted mixed surfacing.

North Dakota gravel pits run about one-third retained on a ¼-inch screen, and gravel of this grading is used for surfacing. At least five per cent of the material should pass a 200 mesh sieve, but only a small percentage of these fines should be clay.

The preparation of the gravel surface to receive the oil mix is identical with the preparation for a penetration treatment. The first step in the process after the gravel has been delivered in a windrow on the shoulder of the road is to get the material dried out and thoroughly and uniformly mixed. It is turned over by means of a power grader, the number of times the gravel needs to be turned depending upon the weather and the amount of water in the gravel. The drying usually requires more manipulation of the material than the mixing. No gravel comes from our pits dry enough to mix properly with the oil. After the gravel has dried out sufficiently it is left in a windrow to be spread just ahead of the oil application.

The oil used for this type of surfacing contains approximately 65 per cent of asphaltic residue of 80 penetration; has a viscosity of 250 Saybolt-Furol, and the asphaltic residue must show a ductility of not less than 6 cm. at 34° F. The amount of oil used is determined from the formula $P = .021a + .042b + .24c$, where P is the percentage of oil by weight in the total mix; a = the percentage of total aggregate retained on a 10-mesh seive; b = the percentage of total aggregate passing a 10-inch sieve and retained on a 200-mesh sieve; and c = the percentage of total aggregate passing a 200-mesh sieve. (This is McKesson's Formula, plus 40%.)

One half of the gravel was spread and treated at a time. A half-mile was the length of section treated each day. The oil was spread with a pressure distributor, each application being at the rate of approximately one-third of a gallon per square yard. This requires four 1000-gallon loads for a half width one-

When All the Material Has Been Oiled It Is Left in a Windrow on One Shoulder. Three Blades Now Take Up the Mixing

half mile long. Immediately behind the distributor came a small caterpillar tractor pulling a double disc harrow and a spring tooth harrow. These harrows do a large percentage of the mixing and are kept constantly at work until all the oil has been applied and harrowed in. The treated gravel is then bladed into a windrow on the side of the road and the balance of the gravel given a similar treatment, and placed in the same windrow.

At this stage the three power graders take up the mixing work. They travel in echelon and pass the material entirely across the road on each trip. Special mould-boards were provided which were higher and more concave than the standard mould-board provided with most types of motor graders. The number of times that the gravel must be passed back and forth before it is thoroughly mixed depends on the material and on the temperature, but as this part of the work is very essential the mixing was not slighted.

After the mixing had been completed, the material was left in a windrow on one shoulder until the large power grader was ready, which spread it uniformly over a 20-foot width. The compacting was done by traffic, light blading meantime keeping out traffic ruts and giving a remarkably smooth riding surface.

Plant-Mixed Method

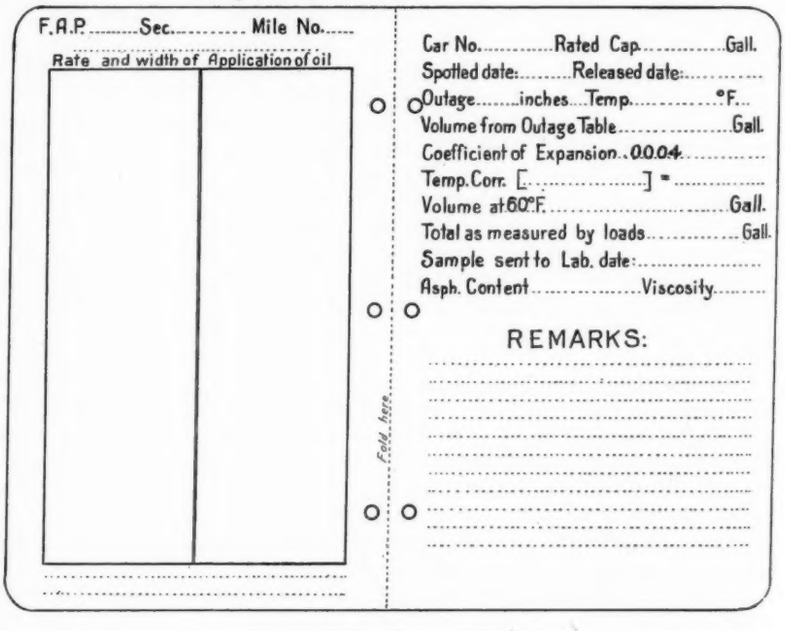
While the oil mix surfacing was developed by the mixed-on-the-road method, it is not the only method in use today for constructing this kind of a top. In fact, the states that have used this surfacing material the longest show a decided tendency to abandon the mixed-on-the-road method for a plant-mixed product. In this the oil and gravel are mixed in concrete mixers at the gravel pit or plant, and hauled out onto the road ready to spread. The mixed material hauls and spreads as readily as the gravel alone.

In order to have all the equipment working to maximum efficiency in the mixed-on-the-road method, we would have a power grader drying and spreading gravel on one half-mile, the distributor and harrows applying the oil on the second half-mile, the three blades mixing on the third half-mile, and the big blade spreading on the fourth half-mile. This is fine if it doesn't rain; but sometimes it rains and then all the material in whatever stage of the processing must be dried out before the work can progress. Other arguments in favor of the plant-mixed method are that there is much less inconvenience to traffic; a better type of oil can be used; a more uniform product can be turned out, and a longer working season is possible. Here in North Dakota, where the type of aggregate available is not as good as can be obtained in many states, the necessity of doing everything possible to improve our product is important and the plant mix is being given careful study.

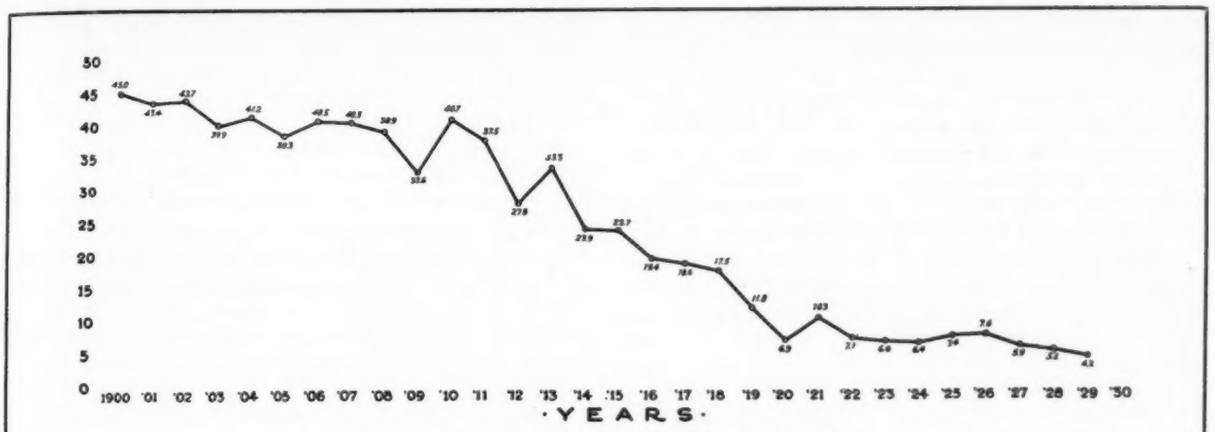
The cost of the oil and the mixing is about $2000 per mile. (Oil $1400 to $1500 and processing $500 to $600 per mile.) The cost of the gravel will vary with the location of the project more than will the other factors.

Maintenance

Ramond Harsch, materials engineer for Idaho, at the 1929 meeting of the Western Association of State Highway Officials expressed a conception of maintenance that is worthy of repetition. He said: "It has been our observation that the maintenance costs [of bituminous surfaces] are not essentially an expense for repairing the oiled surfacing, such as small surface ravels, edge breaks, etc., but are the result of attempting to construct an oiled surface on the existing gravel surfacing which had not proved adequate to carry the traffic before the oil treatment." And further he said: "If the occasional subgrade failure was eliminated from the list of maintenance requirements of oiled surfaces, and the cost of repair, considered under the head of preparation of the road to receive treatment, a different maintenance expense story would be told."


F.A.P. ..... Sec. ..... Mile No. .....
Rate and width of Application of oil
Fold here
Car No. ..... Rated Cap. ..... Gall.
Spotted date: ..... Released date: .....
Outage ..... inches Temp. ..... °F.
Volume from Outage Table ..... Gall.
Coefficient of Expansion .0004 .....
Temp. Corr. [.....] = ...
Volume at 60°F. ..... Gall.
Total as measured by loads ..... Gall.
Sample sent to Lab. date: .....
Asph. Content ..... Viscosity .....
REMARKS:

Standard Field Book Form



Typhoid Fever Reduction in Maryland, 1900-1929

Sanitary Engineering Activities of the Maryland Department of Health

Experiments on pre-chlorination of sewage, plankton and sewage pollution are reported on. Duties of division now include supervision of operation of plants at State institutions.

From a report by ABEL WOLMAN, Chief Engineer, Bureau of Engineering

The annual report for 1929 of the Bureau of Sanitary Engineering of the Maryland State Department of Health shows, as it usually does, a most favorable and progressive condition and activity of the department and of the general health of that state. Special mention is made of the declining typhoid fever death rate. There were only 67 deaths from this disease in 1929, the lowest in the history of the state, giving a death rate of 4.2, that for Baltimore City being 3.2 and for Maryland exclusive of that city being 5.2 per 100,000. In 1910 the typhoid death rate for the state was 42.8, for Baltimore City 41.9 and for the state exclusive of that city 43.5. There has been a contiuous decrease since that year, the maximum decline having been between the years 1913 and 1919, the typhoid rate in the latter year having been 11.7, 8.2 and 15.3 respectively.

During the year $4,900,000 was spent in the state of Maryland for sanitary work, of which $3,335,000 was spent in the city of Baltimore.

One of the interesting activities of the bureau was the investigation and the control of berry pickers' camps. Investigations were made of approximately 25 of these camps and sanitary conditions in many of them were found to be of the worst. Corrections were made in a few, and it is hoped by repeated surveys and recommendations in the next few years to secure important improvements.

Water and sewerage plants were installed in a number of the state institutions and improvements made in others, most of them along lines which have become standardized in the state. In one case, that of the improvement of the water supply at the Maryland Tuberculosis Sanatorium, Mt. Wilson branch, contract was let for a 100,000-gal. elevated tank on a 100-foot tower and for a gravel packed well guaranteed to deliver 200 gallons per minute, the contract providing that in case the well did not supply the guaranteed amount of water the contractor was not to receive any money. Pumping tests on test wells constructed by the contractor indicated that the guaranteed amount of water could not be obtained from underground sources and the contractor abandoned the contract.

Other possible sources of supply were either too expensive or too polluted and it was thought probable, at the time the report was written, that the most favorable plan would be to connect with the mains of Baltimore City and take the water supply from them.

SUPERVISION OF PLANTS AT STATE INSTITUTIONS

"In the last annual report it was stated that the Bureau had assumed the direct supervision of the operation of the water and sewage treatment plants at four state institutions. In October of the present year (1929) this number was increased to nine, with an engineer of the Bureau devoting his full time to the work. Each institution contributes a small sum annually to the Bureau to meet the salary and expenses of the engineer in charge of the work. The yearly sums per institution vary from $250 to $600. The total amount available for this service is $3,400 per year.

"Under this arrangement the supervising engineer, under the Bureau's direction, makes at least one visit to each institution every month and assists and instructs the operator in handling the various problems relating to his plant. Improvement has been noted both in the plants and in the attitude of the operators since this plan has been in effect. Sewage plants which formerly received attention at rare intervals are now

being regularly taken care of, and water treatment plants are operated more intelligently.

"One instance of the value of this supervision was indicated when, at an inspection of one of the plants, it was found that the person who had been making orthotolidin tests for residual chlorine had been sick in bed for two weeks, during which time no tests were made. The water supply of the institution is obtained from springs and is treated with hypochlorite of lime.

"Tests for residual chlorine were made by our supervising engineer. These failed to indicate the required residual and an inspection of the treatment plant was made. The operator was treating the water as usual, with one 12-ounce can of hypochlorite per day. Further investigation indicated that a new supply of hypochlorite had been in use for about eight days. Although this hypochlorite was marked "available chlorine not less than 24 per cent," a test of its strength indicated only 0.33 per cent of available chlorine. Further investigation showed that several cartons of this material had been in the storeroom of the institution for approximately one year, with the resultant deterioration. Immediately arrangements were made to obtain a new supply and specifications for future purchases were furnished.

"Prior to the present arrangement of supervision, this institution was visited about four times a year. Had this procedure still been in effect, untreated water would have been supplied to the patients for several months, under the assumption that it was being properly disinfected. In the absence of a full-time trained operator for each institution, usually impracticable of attainment, this type of supervision is essential."

PRECHLORINATION EXPERIMENTS

"At the Eudowood Sanatorium sewage treatment plant, the first of the State to inaugurate the prechlorination of sewage, an effort was made to study the bacterial stream quality phase of the prechlorination of sewage. The study thus far has continued over a period of several months, and, while further corroborative data are now being obtained, it is already apparent the procedure is practicable and warranted.

"Briefly, it was the object of this study to determine the most economical chlorine residual in the tank effluent necessary to effect a bacteriological stream quality as good as, but no better than, the quality obtaining above the treated sewage influent. The chlorine residual in the tank effluent necessary at this plant to maintain a B. coli content in the sewage of less than 1 per c.c. lies between 0.1 and 0.2 p.p.m.

PLANKTON AND SEWAGE POLLUTION

"At the Bureau's request a joint study of Back river was made with the Baltimore City Bureau of Sewers. The purpose of the investigation was to determine the chemical and biological character of the stream at points above and below the outfall of the Baltimore sewage works and the significance of this discharge in the seasonal incidence of certain types of plankton, particularly the algae. Thirteen surveys covering seven stations above and below the outfall were made every ten days from July to November. In addition to field observations and tests, both departments made chemical examinations, and the Bureau of Sewers made quantitative microscopic plankton tests. Data are being assembled and correlated by each Bureau and reports will be submitted.

"There is undoubtedly a concentration of nitrogen in this section of Back river in form suitable to support the growth of the visible type of vegetable plankton such as the algae. The relative shallowness, particularly of the upstream portion of the river, provides conditions favorable for a maximum of photosynthetic stimulation of algae growth when air temperatures are high and clouds and rainfall are light. The conditions found shed considerable light on the desirability of providing sufficient dilution water in streams receiving highly nitrified sewage treatment plant effluents."

TREATMENT OF LAUNDRY WASTES

"Results of our studies on the disposal of laundry wastes at the Franklintown Laundry, begun in 1926, indicate that treatment consisting of 15 g.p.g. of sulphuric acid and 7.2 g.p.g. of ferrous sulphate produces a satisfactory effluent at a minimum of expense and with no operating troubles."

Abel Wolman is chief engineer of the Bureau of Sanitary Engineering.

Water Tank Destroyed by Ice

Until a few weeks ago, West Salem, Ohio, was served with a 40,000-gallon tank as a part of its municipal water supply system. This provided the only storage for the town and was filled by water pumped from wells.

A few weeks ago it sprang a leak, apparently near the top, and the water leaking out froze as it issued until about 20 tons of ice had collected on one side of the tank. This caused stresses which the supporting tower had not been designed to carry and it collapsed.

A. H. Fretter, superintendent of water works of Medina, Ohio, who has furnished us with the information and photographs, says that the cover was thrown about two hundred feet from the tank, shearing off a cherry tree 12 to 14 inches in diameter that stood about 120 feet from the tank, and carrying the bottom of the tree with it so that the top of the tree rested on its stump. The spider out of the top fell between the tank and the tree.

Draining, Grading and Paving the Detroit City Airport*

By Perry A. Fellows

City Engineer, Detroit, Mich.

During the past eighteen months, the Department of Public Works of Detroit, through the Airport Division of the City Engineer's Office and its Construction Division, has converted a rough, swampy river bed into an airport. This river-bottom, 200 feet wide, 20 feet deep, its banks and borders covered with dense underbrush, and used as a rubbish dump, has been graded, provided with fences, turf, concrete and asphalt runways, fuel, hangar and other facilities.

The Detroit City airport is one of the outstanding examples of close-in location. It lies well within the city limits, five miles northeast of the city hall and four and one-half miles due north from the river at Belle Isle bridge. The Detroit terminal railroad is an industrial belt line and its right-of-way adjoins the southern edge of the airport for more than a half mile.

The area of the field is now approximately 270 acres. Authorized additions will increase this to 300 acres in the near future. The land now owned by the city is in two strips separated by French Road. The plan to consolidate these parcels by vacating the street which lies between them has recently been approved by court decree.

Planning the Drainage

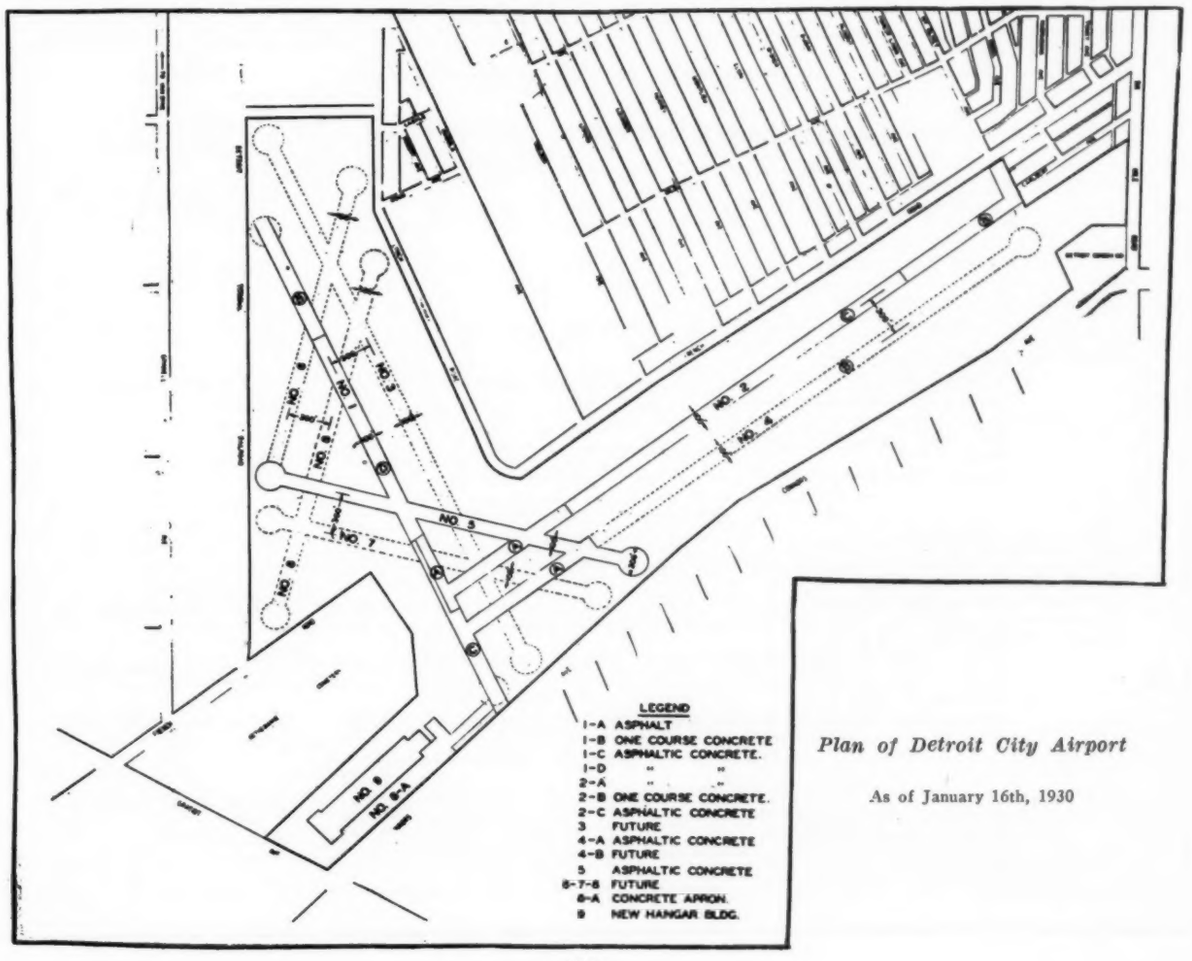
In addition to the large trunk sewers which extend the length of the airport, and which form a part of the city sewer system, there is a complete drainage layout consisting of laterals, drain tile and catch basins. This network is installed gridiron fashion over the field and is connected into the large Connors Creek sewer underlying the airport.

To drain adequately the 250 acres within the airport boundaries required five miles of 12-inch to 18-inch lateral sewers and seventeen miles of 4-inch and 6-inch drain tile laid in trenches backfilled with one-half-inch stone. These trenches were for the most part in parallel lines fifty feet apart.

The tile in these trenches was laid on a one per cent grade and the depth of the tile below the surface was from three to four feet.

The drainage system for a number of airports has

* From a paper before the Engineers' Club of Philadelphia.



Plan of Detroit City Airport

As of January 16th, 1930

been worked out on the basis of soil characteristics very much as golf course drainage or farm drainage is designed.

The planning of such work on the basis of intensities of storms and time of run-off for maximum economy has been conspicuously lacking. The importance of this latter form of investigation should receive greater emphasis. In Detroit the great variety of filling materials that went into the preparation of the field tended to render the results of a soil survey less informative than is ordinarily the case. The plan to build ultimately a comparatively large area of hard surface runways and aprons made the soil characteristics and tile drainage of less significance than it might otherwise have been.

The limited experience with the completed drains in the Detroit city airport indicates that they are satisfactory.

Preparation of the Surface

Work at the airport has progressed on the full length of both sections of the field. The filling of the creek bed which traverses the field has been done during the past two years by opening it as a dump for excavated material from city paving operations, sewer tunnels, excavations for building foundations and to a limited extent for a rubbish dump. Over 1,000,000 yards of fill were needed to bring the old gully up to the level of the landing areas. Other work incidental to the preliminary preparation of the field included the removal of buildings, trees and brush, fences, old subdivision sidewalks, telephone and electric light poles and other things within the limits of the field. In the westerly portion of the field a $200,000 garage and repair shop belonging to the water bureau of the Fire Department was vacated by them in June, 1928 and the building razed. The salvage materials were used so far as possible in the reconstruction of the building on another site on the west side of the city.

Grading operations have been carried on with a view to having a smooth surface with no slope more than two per cent in any direction. The fills in some instances have exceeded 30 feet and allowance for shrinkage was necessary. A finish layer of top soil has been placed to make it possible to grow a sod on the field.

The areas have been brought to grade and harrowed, fine graded, seeded and rolled. Various seeds were used, some bluegrass and special mixtures. Vetch was sown in poor soil and some rye was used to protect the younger plants where needed.

Runways and Runway Surfaces

There is no general agreement in the practice of surfacing the runways; some feel there must be a definite choice between hard surface runways or a sod surface over all. We do not agree with this limit-

RUNWAY AND APRON DATA
Including Grading and Drainage

Symbols	Type of Construction	Length	Width	Sq. Yds.	Cost	Unit Cost	Remarks
Main Hangar Apron	7" 1-Course Concrete	Approx. 1,200	150	20,415	$40,122.60	$2.03*	(Contract) Otis Cem. Const. Co.
1—A	3" Sh. Asph. on Water Bound Macadam Base	500	100	6,000	18,000.00	3.00†	(D.P.W.) Force Acct. Built in Midwinter Blasting
1—B	7" 1-Course Concrete (Alley Type Crown)	1,000	100	11,278	22,137.00	2.02*	Contract Smith Paving Co.
1—C	2" Asph. Concrete on 5" Black Base	800	100	8,900	14,240.00	1.60†	(D.P.W.) Force Acct.
1—D	2" Asph. Concrete on 5" Black Base (Street Type Crown)	1,800	100	19,136	30,333.43	1.58*	(D.P.W.) Contract
2—A	2" A.C. on 5" Black Base (Street Type Crown)	1,000	100	11,280	18,048.00	1.60†	(D.P.W.) Force Acct.
2—B Runway and Apron combined	7" 1-Course Concrete (Alley Type Crown)	1,250	100	13,680	25,034.40	1.83*	Contract Otis Cem. Const. Co.
2—C	2" A.C. on 5" B.B. (Street Type Crown)	2,800	100	30,978	49,783.58	1.61†	Contract Detroit Asphalt Pav. Co.
4—A	2" A.C. on 5" B.B. (Street Type Crown)	1,000	100	11,280	18,048.00	1.60†	(D.P.W.) Force Acct.
5—	2" A.C. on 5" B.B. (Street Type Crown)	2,800	100	31,146	47,064.30	1.66	Detroit Asphalt Pav. Co.
		14,150 (2.6 Mi)		164,093	$282,811.31	Average $1.72	
	Average Cost of Concrete					$1.92	
	Average Cost of Asphalt					$1.57	

*=includes Inspection (6c per Sq. Yard)
†=estimated

ing choice but believe that the two types can be combined to good advantage.

The design and construction of runways is the feature of airport engineering that falls to the lot of the highway engineer. Only by means of a long, comparatively smooth surface are airplanes enabled to take-off and land at the prevailing high speeds. Not only is this a present condition, but if the airplane continues to develop along existing lines long runways will be required for some time to come. Average landing speeds have increased rather than decreased in recent years, and not even the most optimistic or radical of engineers can build an airport solely for helicopters. Only two or three years ago a landing speed of fifty miles per hour was common in commercial work, whereas sixty miles per hour is quite normal today. An airport designed to occupy a permanent place in national aviation must possess runways that are safe and convenient under all conditions.

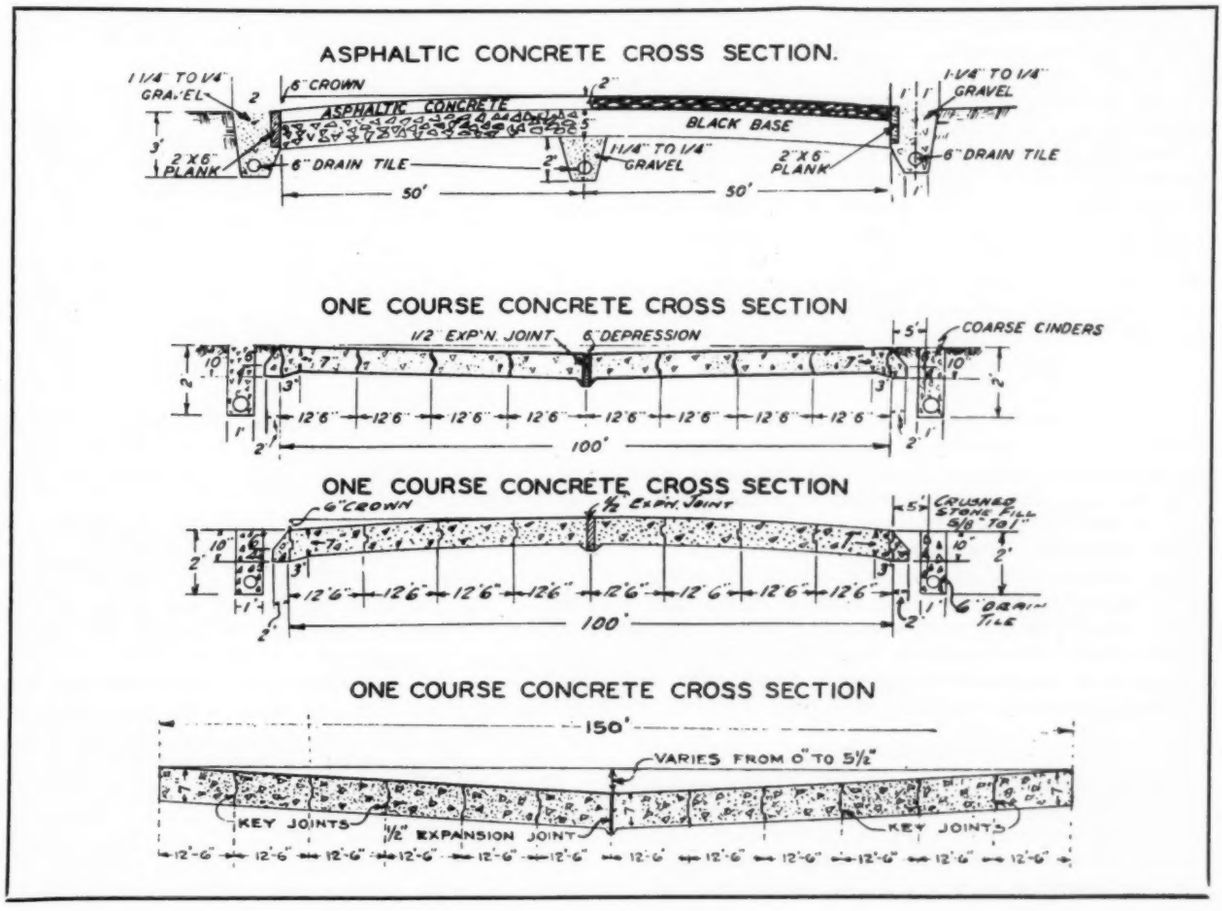
Sufficient length to allow the plane to come to a stop after a poor landing is therefore the most obvious requisite of a landing field. A hard surface with satisfactory degree of smoothness is equally important, because if the wheels are unduly retarded the plane ends to revolve about them, and when the overturning moment becomes greater than the resisting moment, the result is unfortunate. A strong wind across the runway tends to whip the plane off its course, and so it is important that the plane head into the wind when landing, necessitating runways in more than one direction.

The Detroit city airport has three runways, two of these are 80 degrees apart, and intersect at their lower ends. Each runway is ultimately to consist of two 100 foot wide pavements, 300 feet apart on centers. The North-South runway has a length of 4,900 feet and the East-West runway a length of 4,150 feet. The prevailing winds closely parallel the latter approach. A taxi strip near their intersection connects the runways with the concrete apron fronting the hangars. The third runway crosses both of these near their intersection.

Thus far, to accommodate planes landing and taking off, 3,450 lineal feet of concrete runways have been built at a cost of $87,295.00; 7,900 lineal feet of asphaltic runways at a cost of $148,452.58. All runways are 100 feet wide and completely drained. In addition, approximately 1,800 lineal feet of concrete aprons have been constructed at hangar approaches. These aggregate over 25,000 square yards of surface, varying in width from 100 to 150 feet.

The use of hard-surfaced runways will undoubtedly increase at airports where a schedule of flights must be maintained in all kinds of weather. At the Detroit airport such pavements are especially needed because clay forms a large part of the soil, and this cannot be expected to drain quickly in wet weather, despite the system of drain tile now being installed. It is planned to provide more runways when the additional area is annexed to the airport.

Three types of pavement have been used to surface the runways: one-course plain concrete; sheet asphalt on water-bound macadam base; and two-course bituminous concrete. The hundred-foot width of the con-



crete one-course pavement is laid in eight strips with a longitudinal, premoulded expansion joint between the two central strips. Transverse expansion joints filled with premoulded mastic are placed every thirty feet. The slabs are edged to a half inch radius. The thickness of the slab is seven inches.

Concrete Pavement Specifications

The specifications are the outgrowth of long experience with one-course concrete streets and alleys in Detroit. A field mix of 1:2:3 is specified, with either pebbles or crushed stone permitted for the coarse aggregate. The grading of the sand is fully detailed and its fineness modulus must be between 2.60 and 3.60. Pebbles have a fineness modulus between 7.00 and 7.80, and range in size from 2-inch to ¼-inch. Crushed stone is also graded from 2-inch down and must meet specified tests for hardness, toughness and wearing quality. As in other city paving, water content is indirectly controlled through the consistency of the mix. A maximum slump of three inches is permitted, and to minimize variation it is specified that the mixer must have a water measuring tank with a visible gauge. The time of mix is one minute.

Adequate curing of the concrete is secured by keeping it wet for seven days. Because it is recognized that plastic concrete contains more than enough water for complete hydration if evaporation is prevented, curing by silicate of soda has been permitted in the sections so far constructed. In this case the slab is covered with burlap as soon as it is finished and kept wet until hard enough to permit the application of the sodium silicate.

The obligation of the contractor to produce concrete meeting definite strength requirements is checked by test results. Cylinders made from the concrete going into the pavement must develop a strength of 2,500 pounds at the age of 28 days. Slab thickness as well as strength is determined by cores drilled from the completed pavement. These cores must show a compressive strength of 2,500 pounds at 28 days, 3,200 pounds at 90 days and 4,000 pounds at one year.

Two sections of concrete runway under contract have been completed. Cores taken from these sections and tested at 28 days averaged 3,992 pounds per square inch. The individual core tests ranged as follows:

5360	2495
4520	3900
4370	3310
Average 4750	Average 3235

The cylinders made from this concrete showed an average strength of 3,362 pounds. Three cores taken from the concrete apron broke under an average unit load of 3,407 pounds. The corresponding apron cylinders averaged 2,779 pounds per square inch.

The one-course concrete was laid under three separate contracts. One of these was for 20,415 square yards; one for 11,278 square yards and one for 13,680 square yards. The total cost was $87,294.10 and the average unit cost was $1.93 per square yard, including six cents per square yard for inspection.

Bituminous Pavements

The bituminous concrete, or black base pavement, is more of an innovation in this city than the other type, but it is the belief of the engineers that it will be satisfactory for the kind of traffic for which it is designed. The fact that there is a large city-owned asphalt plant on the airport property made this kind of construction especially feasible. It consists of two inches of sheet asphalt over five inches of asphaltic concrete. The width is 100 feet and the cross-section shows a six inch crown at the center. A line of porous six-inch tile in a gravel filled trench is laid under each edge and the center line.

The asphaltic concrete base is a mixture of asphaltic cement with coarse and fine aggregates conforming to the following composition limits by weight:

Passing 2½-inch screen, retained on 1¼-inch	15 to 45%
Passing 1¼-inch screen, retained on ¼-inch..	15 to 45%
Passing ¼-inch screen	25 to 40%
Bitumen (asphalt cement soluble in carbon disulphide)	4 to 7%

This mixture is delivered at a temperature of 225 degrees F. to 325 degrees F. and laid on a dry sub-grade. It is laid in two layers so that it can be more completely compacted.

Part of the section of black base lies over a filled-in water hole. The pressure of the roller served to bring water to the surface, producing muddy spots on the base. Spreading hay over the sub-grade prevented recurrence of this trouble.

The surface course consists of asphaltic cement, sand and mineral dust, mixed to produce the following composition:

Bitumen	6 to 7.5%
Mineral matter passing 200-mesh screen..	6 to 8%
Mineral matter passing 80-mesh screen...	8 to 10%
Mineral matter passing 40-mesh screen...	12 to 15%
Mineral matter passing 10-mesh screen...	8 to 10%
Mineral matter passing ¾-mesh screen....	45 to 55%

The asphalt mixtures for the sections constructed by the Department of Public Works were prepared at the neighboring municipal asphalt plant on French Road.

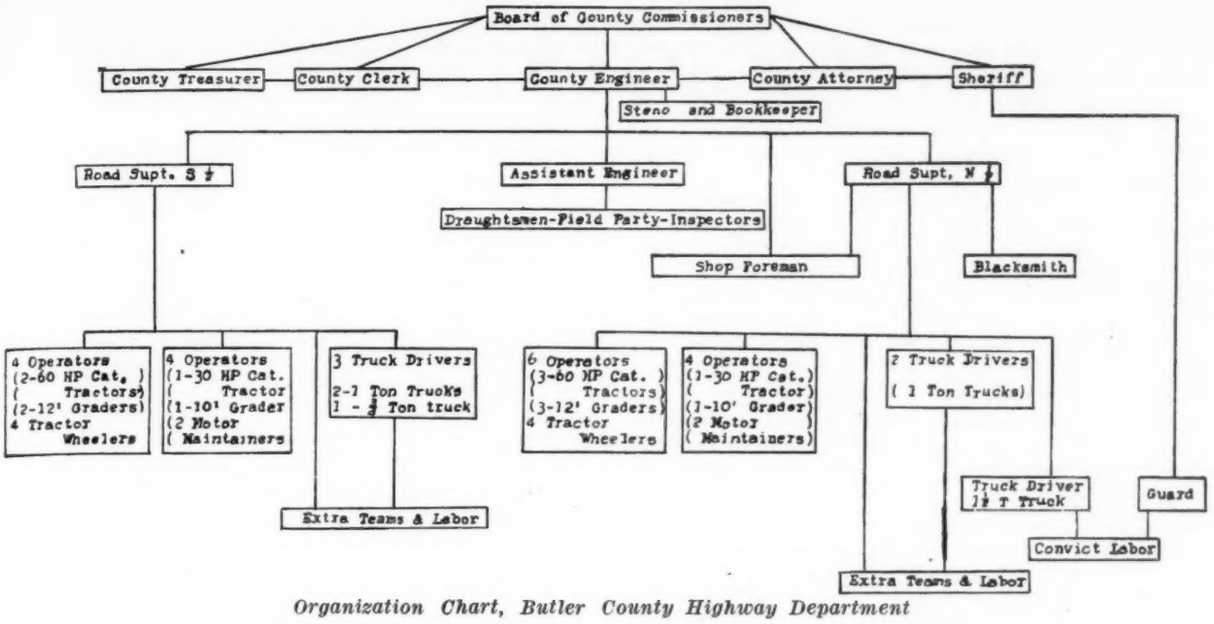
The asphaltic concrete runways were built as six different jobs. Two of these aggregating 62,124 square yards were contracted by the Detroit Asphalt Paving Company for a total of $96,847.88. The unit cost on one job was $1.61 per square yard and on the other was $1.66 per square yard, including the six cents per square yard inspection.

One section of the asphaltic concrete was built by the Construction Division of the Department of Public Works, under contract secured by competitive bidding; 19,136 square yards costing $30,333.43 were included in this contract. The unit price $1.58 included six cents for inspection.

The three remaining sections of asphaltic concrete were built by the Department of Public Works under force account. These amounted to 31,460 yards and cost $50,336.00.

One section of runway 500 feet long was built during the winter when it was planned to hold the All-American Aircraft Show at the City Airport. Because of the fact that the ground was frozen it was necessary to resort to blasting to prepare the grade. This section was built as a 3″ sheet asphalt top on a 12″ water-bound macadam base. The cost was not segregated from other work done at the same time, but is estimated at $3.00 per square yard, because of the unusual conditions under which the work was done.

The totals for hard surface completed are 164,093 square yards for a cost of $282,811.31. Plans are being prepared for additional strips. The average unit cost is $1.72 including inspection. In every instance the usual grading and drainage were included.


Board of County Commissioners
County Treasurer
County Clerk
County Engineer
County Attorney
Sheriff
Steno and Bookkeeper
Road Supt. S ½
Assistant Engineer
Road Supt. N ½
Draughtsmen-Field Party-Inspectors
Shop Foreman
Blacksmith
4 Operators (2-60 HP Cat. Tractors) (2-12' Graders) 4 Tractor Wheelers
4 Operators (1-30 HP Cat. Tractor (1-10' Grader (2 Motor Maintainers
3 Truck Drivers 2-1 Ton Trucks 1 - ½ Ton truck
Extra Teams & Labor
6 Operators (3-60 HP Cat. Tractors) (3-12' Graders) 4 Tractor Wheelers
4 Operators (1-30 HP Cat. Tractor) (1-10' Grader) (2 Motor Maintainers)
2 Truck Drivers (1 Ton Trucks)
Truck Driver 1½ T Truck
Guard
Convict Labor
Extra Teams & Labor

Organization Chart, Butler County Highway Department

Organization of Butler County Highway Department

Duties of the several officials of a Kansas county containing twenty-five hundred miles of roads. Records kept. Some details of construction and maintenance methods.

By E. S. Elcock *

Butler county, Kansas, the largest county in the state, has an area of 1470 square miles, which is served by a total of 2500 miles of highways. Of these, 120 miles are state highways, 270 miles are county roads, and 2110 are township roads.

The state and county roads form a network which brings 75 per cent of the area of the county within two miles, and 90 per cent within three miles, of a state or county road and connects every town in the county with every other town by a direct route. The county roads are laid out and improved with the idea always in mind of connecting with the state roads as quickly as practicable.

The traffic carried by the roads is composed of 84 per cent automobiles, 14 per cent trucks and 2 per cent horse-drawn vehicles. The high percentage of truck traffic and the fact that, due to oil field development, the traffic proceeds regardless of weather, calls for an unusually heavy type of maintenance. Motor maintenance is the only type which will produce a satisfactory surface.

GENERAL ORGANIZATION

The general organization of the County Highway Department is composed of the following elective officers: Board of county commissioners (three members), county clerk, county treasurer, county attorney, and county sheriff. The county engineer is appointed by the board of county commissioners.

The county commissioners determine the policies of the department, provide funds for the department, designate the improvements to be carried out, regulate the wage scale, conduct hearings on matters presented by the public, obtain needed rights of way, and award contracts for work not done by the department's forces.

The county clerk keeps the records of the commissioner's proceedings, receives and files petitions, and files all bills.

The county treasurer has the funds of the Highway Department in his custody and pays claims on warrants issued by the county commissioners, but does not direct the financial affairs of the department.

The county attorney approves the legality of all bills and represents the department in the courts.

The sheriff is responsible for the custody of the prison labor used by the department and, with the county attorney, is required to make a semi-annual invoice of all the personal property of the department.

The county engineer supervises the preparation of plans, specifications and estimates for all road and bridge work; supervises all construction under contract; prepares payment estimates and approves all work done by contract. He makes a yearly budget for the department, supervises all work done by department forces, approves all purchases of machinery, material and supplies, and makes cost analyses of work done. He employs all engineering personnel, stenographer and road superintendents, and approves employment of all employees. The engineer also acts as

*County engineer, Butler Co., Kansas.

advisor to all township boards on matters concerning township roads and approves all expenditures for materials or machinery in excess of $200.

The stenographer and bookkeeper is employed on stenographic work approximately 10 per cent of the time, and the remainder on bookkeeping. Records are kept as follows:

(A) Road Construction and Maintenance:—A detailed record of each day's work as to class of work done and location of work. The road superintendents furnish reports monthly where each day's work of each employee is done. Rental charges are made for each piece of equipment and shown as a charge against the work performed.

(B) Bridge Construction and Maintenance:—A detailed record of work done and money expended for construction and maintenance of each structure.

(C) Bridge Record:—A description of each structure constructed by the department. Each bridge has a descriptive number which indicates its location, e.g. No. 17N265 indicates that the bridge is on the north line of section 17, township 26, range 5.

(D) Equipment Operation Account:—A detailed record of all operation costs of each piece of equipment.

(E) Stock Record:—A continuous invoice of all repair parts, tools, etc., carried in stock at the shop. Each article is listed on an individual sheet and the number received and checked out is recorded each month, so that the office can tell at a glance what is in stock at any time.

Summaries and analyses of these records, made at the end of the year, are very valuable in checking wastes and in making up the budget for the coming year. Charts are prepared each year showing operation costs of all equipment and expenditures in dollars per mile per year for each type of work done on every road.

The assistant engineer has charge of field work in the preparation of plans for road improvements and bridge work; directs detailing of plans in office, and directs the activities of inspectors on bridge work. He also makes land surveys. The office and field force ordinarily includes 1 assistant engineer (who is a technical graduate); 1 draftsman and tracer (not technical graduate) who also acts as instrument man; 1 rodman; and, during the construction season, 2 inspectors, who are usually engineering school students on vacation. They are furnished with two automobiles by the department, or sometimes use private cars on a mileage basis. All bridge and culvert work is done by contract, and there is always an inspector on the job when concrete is run.

Maintenance of the county's graded roads is all done by day labor under the direct supervision of two road superintendents, one having charge of the north half of the system and the other the south half. These superintendents are employed on full time and are paid a monthly rate for furnishing their own transportation. They employ all road employees, subject to the approval of the engineer.

Maintenance is by motor patrol exclusively. The department operates five "60" Caterpillar tractor and 12-ft. grader outfits; two "30" Caterpillar and 10-ft. grader outfits; and four one-man motor maintainers. While the heavy outfits are usually on construction projects, they are held available for maintenance and are used for maintenance when conditions demand. The lighter outfits are used mainly for maintenance but also occasionally for construction work, smoothing fresh grades behind the heavier outfits.

New grading work is done entirely by day labor work under the road superintendent. Not much attempt is made to reduce grades, as the country is mostly rolling and excessive grades are not common. New construction is principally blade grade work, the only heavy grading being raising grades in river bottoms above high water and making fills around culverts.

No construction surveys are made except where yardages are heavy. Large fills and heavy cuts are cross-sectioned, a grade laid and staked in the usual manner.

Surfacing of county roads is done entirely by contract under supervision of the engineering department. All surfacing material is shipped into the county by rail, no suitable local materials being available.

Until the past year, all heavy drifting and fill work was done by hiring extra teams, but now the policy is to do this work with tractor wheelers and fresnoes on account of the scarcity of good teams.

Each road superintendent has two trucks for general hauling of materials, supplies, light tools and gasoline. These trucks are also used to haul extra gangs of men who are employed from time to time for bridge repair work, fence building, clearing and incidental work. When extra teams are hired, they are worked in gangs of 4 or 5 teams, and a truck driver acts as foreman of the outfit.

The convict gang, which ranges from time to time from 5 to 20 men, is in charge of a truck driver and a guard. They are mostly employed on clearing, fence building and rock work. The sheriff has a deputy who is guard over the gang.

Maintenance of equipment is in charge of a full time shop foreman, who is an expert mechanic; he orders all repairs and tools and supervises major repairs. Minor repairs are made from time to time by the operators, who also act as helpers to the shop foreman on major repairs.

The department maintains one large shop in charge of one road superintendent and the shop foreman, and a small shop in charge of the other superintendent.

The large shop has a forge and trip hammer, and a full-time blacksmith is employed to sharpen grader blades and do general blacksmith work.

Tractor operators, grader men and maintainer operators are paid by the day and furnish their own transportation. They work practically full time except during exceptionally severe winters.

Truck drivers are employed by the day and work practically full time. Extra men and teams are employed by the day as needed.

Engineering employees are employed on a monthly basis.

Debt Limit Proposed for New York State Towns

The adoption of a constitutional amendment imposing a definite debt limit of 25% or 33 1-3% on towns is proposed by the New York State Joint Legislative Committee, headed by Senator L. G. Kirkland, which has recently completed its study of the government of towns in New York State. The 10% constitutional debt limitation under which the cities operate does not apply to the towns. As a result of the establishment of a number of different kinds of special districts for the development of particular activities in which all or parts of towns are included, many towns are now bonded in amounts considerably in excess of the 10% limit fixed for cities. The bulk of this special district debt is primarily payable from special assessments.

THE EDITOR'S PAGE

Highway Sidewalks

"It is almost universal in connection with town, county and state highways that the entire roadway which was formerly available for pedestrians is now taken up with more or less congested automobile traffic, with no sidewalk provisions, rendering the streets absolutely unsafe for pedestrians."

This statement was made by the Committee on Street Paving Design, Construction and Maintenance of the American Society for Municipal Improvements, and the society adopted a resolution recording its belief in the importance of providing sidewalks in connection with all public highways carrying considerable automobile traffic.

This matter becomes of especial interest at this time of the year, when spring is issuing its invitation to visit the woods and fields and the "green gods are calling" those millions of us who would rather see nature afoot than awheel. If those interested in good roads for automobiles think that country hiking has vanished, let them ask the legions of boy scouts, camp-fire girls, nature study clubs and similar organizations; let them note that several of the New York daily papers carry from a column to a page once a week devoted to hiking, and that physicians recommend walking as the best form of exercise for health.

But, as the Boston Herald said a few weeks ago, "where can anyone, residing outside of the larger communites, find a place to safely walk, except around the center of the village or town (if they happen to reside in the center) with which he or she is thoroughly familiar? All this just because the State and County have absorbed all of the walking space on all of the highways and just left the pedestrian a chance to walk at his or her peril in the congested and dangerous highway."

Unfortunately, in many states it seems to be illegal to spend state money for sidewalk spaces. The committee of the A. S. M. I. referred to received replies from 36 states to a questionnaire on this subject: In Illinois and New Jersey the law permits state expense for grading only. State expense for sidewalk construction is permitted in specific cases in Delaware; in unincorporated villages, out of delinquent road tax belonging to towns in Illinois; in congested districts in North Carolina, and wherever safety of public demands it in West Virginia; and on bridges in Florida, Idaho, Indiana and Utah.

In 25 states there is no provision for state expense for this purpose and in another only in towns and villages of less than 3,500 population. Towns and counties in eleven states can incur expense for sidewalks on state highways.

To what extent towns and counties can incur expense for sidewalks on roads they themselves build is not known. But the greatest danger to pedestrians is on the heavily traveled state highways; and it would seem desirable for all organizations interested in hiking, acting for the millions of unorganized pedestrians, to endeavor to secure action by state legislatures directing the expenditure of state funds to provide means for safe walking along its highways.

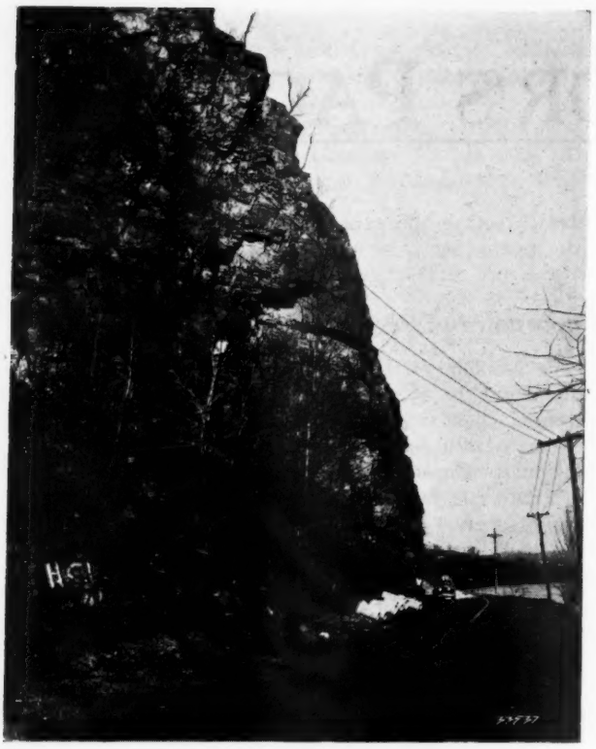
Importance of Personnel in Construction Work

We recommend to the careful consideration of all contractors the following advice by T. Warren Allen, chief of the Division of Management of the U. S. Bureau of Public Roads, contained in an article on "Highway Construction Management:"

"There is a factor in all construction work that very rarely receives the consideration it deserves. It is responsibility. Too often positions of major responsibility are not filled by those who are capable. One such position is the superintendent. Another is the foreman. Others are operators of machines. The employer who realizes the value of a power shovel operator who can excavate 600 cubic yards a day instead of 400 at 50 cents a cubic yard, strange as it may seem, is really a rarity. But he is not so rare as the employer who insists on a capable superintendent—one, for instance, who can increase his employer's profit one hundred times greater than his own increase in salary. There is no limit to the salary in any business that such a man should command. Having secured a capable superintendent, you should give him the authority and support he requires. I have known of too many capable superintendents who were unable to function efficiently because the headquarters office did not honor his requisitions. I know of one contractor who considered paying a bonus to his superintendent in order to speed up work and at the same time refused him authority to hire the requisite number of trucks to keep his concrete mixer supplied."

It is generally understood that, in conducting large business enterprises, the most successful manager is the one who knows how to select his immediate subordinates, delegate a large measure of authority to them and hold tham strictly accountable for results. And the same applies to construction work. A foreman who can so plan his work and manage his men as to secure as much work from fifty men as another foreman does from seventy is earning for his employer the wages of twenty men, and the employer is consulting his own interests by not only paying him an additional amount equal to the wages of one or two laborers, but also keeping him on the pay roll twelve months a year, even if he has no work for him half the time except to look after the equipment standing idle temporarily.

The contractor who thinks he is economizing by turning a power shovel over to a laborer who has learned how to make it work and will do so for a dollar a day more than laborers' wages does not deserve to own a power shovel and probably will not very long. In the comparison made by Mr. Allen above, the shovel operator does not really earn the full $100 a day for his employer—there are additional wear and tear, additional trucks required for hauling, overhead, etc., to be deducted; but he certainly is worth several times a $5 a day increase in salary.



South Side of Base of Mountain Before Blast

An Accurate Blasting Operation

Thirty thousand tons of rock shattered at one blast, but not thrown any distance, in widening a roadway by removing thirty feet of a cliff.

By Lester H. Burns

An unusually large blasting operation on a road project in Eastern Pennsylvania was recently accomplished on the North Delaware River Drive, one mile above Easton, Pa. More than thirty thousand tons of rock were loosened from the face of Weygadt Mountain by the blast.

The cutting away of more than thirty feet from the face of the cliff was ordered by the Pennsylvania State Highway Department, for the purpose of widening the roadbed on the highway, which runs between Martins Creek and Easton. It was also planned to eliminate a dangerous curve that wound around the base of the mountain.

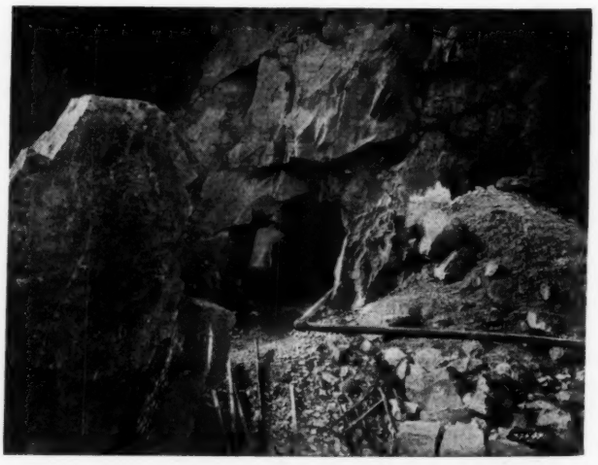
By removing a part of the cliff, which at this point was 200 feet high, it was thought possible to give the highway a better alignment, which is in keeping with the Highway Department's policy of straight, safe roads.

Starting at the level of the old roadbed, a tunnel was driven for a distance of 55 feet into the solid gneiss of which the mountain is formed. At the end of this tunnel, two laterals were driven, one to the right and one to the left. The right lateral was 25 feet in length; that to the left 50 feet.

The tunnel was 4 feet square, with pockets in the laterals for placing the powder. The tunnel was drilled with an Ingersoll-Rand S-49 "Jackhamer" mounted on a column. The nine holes drilled for each round, had a depth of six feet. For blasting, 60 per cent gelatin was used and an average advance of five feet was made at each blast. The muck was removed by wheelbarrow.

Air for the "Jackhamer" was furnished by an Ingersoll-Rand portable air compressor, which was enclosed in an old garage 150 feet from the tunnel opening. During the day while the compressor was operating, the doors of the garage were opened to provide ventilation. They were closed at night and when the compressor was not working as protection against the weather. In all, seven hundred 25-pound kegs of Du Pont black blasting powder were placed in the three pockets of the laterals. In the left lateral, 230 kegs were placed at the extreme end, and 300 kegs were placed in the middle. The remaining 180 kegs were placed in the right lateral. In all, slightly less than nine tons of powder were used. Fifteen sticks of dynamite and two blasting caps were placed in each pocket as primers.

The firing of the charge, which was witnessed by a number of powder experts and officials of the State Highway Department resulted in the removal of the rock almost exactly to the desired line. The rock was



Tunnel Portal at Base of Weygadt Mountain

thrown into good position for handling, and when tll danger from falling debris had passed, the work of removal began. A Northwest steam shovel with a one-yard bucket was used for loading the rock into Mack trucks.

The contractors, Dawes and Norris, had taken a number of precautions to safeguard against damage. Property insurance was taken out. The Lehigh and Hudson Railroad, across the river, was cautioned to withhold trains from the vicinity at the time of the blast. But these precautions were unnecessary. So well had the work been done that not even a pane of glass was shattered in home just a few hundred feet distant.

The work was carried out under the direction of Karl Hamner, of the contracting firm, with the advice of Charles Weaver, combustion engineer of the Du Pont Powder Co.

After Blast. One-Yard Northwest Shovel Loading a Mack Truck

Change in Providence Incinerating Plant

Some changes have been made in the Providence, R. I., incinerating plant (described in PUBLIC WORKS for April, 1928) during the past eighteen months, and these are described briefly for us by Irving Stone, Superintendent of the Incinerator Department, as follows:

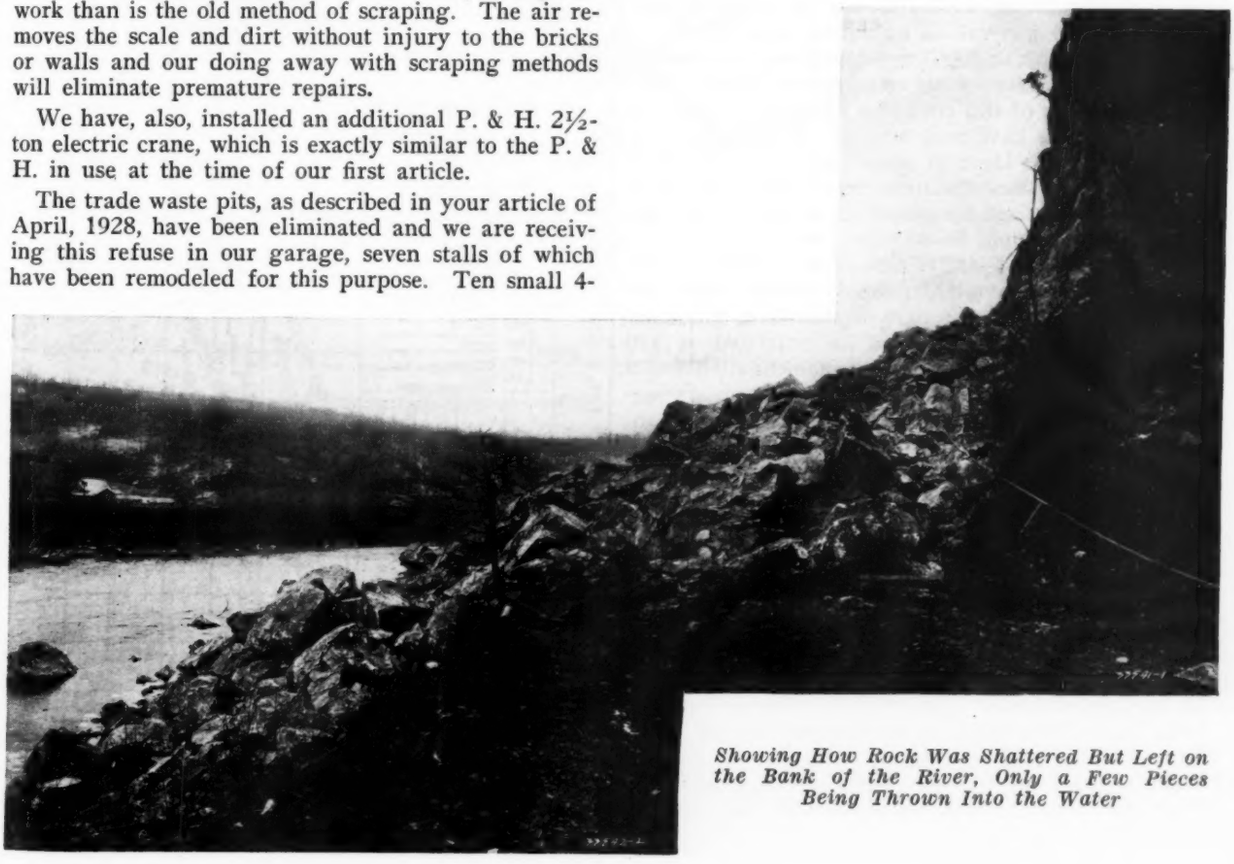
We have recently installed a 15 h.p. Ingersoll-Rand air compressor which we use for blowing out the flues and tubes in the combustion chambers. This method we find, is far more satisfactory in accomplishing this work than is the old method of scraping. The air removes the scale and dirt without injury to the bricks or walls and our doing away with scraping methods will eliminate premature repairs.

We have, also, installed an additional P. & H. 2½-ton electric crane, which is exactly similar to the P. & H. in use at the time of our first article.

The trade waste pits, as described in your article of April, 1928, have been eliminated and we are receiving this refuse in our garage, seven stalls of which have been remodeled for this purpose. Ten small 4-wheel trailers, each carrying one steel tank, are in readiness at all times for the trade vehicles to unload into. When loaded, they are drawn by three Dodge motor tractors from the garage to the plant, where the tanks are taken to the hopper floor for charging into the furnaces or storage, as the conditions may require.

The city is now contemplating the construction of an additional unit of 80 tons capacity. This will necessitate the building of an addition to our plant.

The additional crane, the transfer of the trade waste pits and the planning for an additional unit all came with the increase of work the plant is expected to do. With public's gradually learning the facilities of the plant and what it is capable of disposing of, came the increase of refuse collected and disposed of.



Showing How Rock Was Shattered But Left on the Bank of the River, Only a Few Pieces Being Thrown Into the Water

Water Supply of Northern New Jersey

Recently created State Water Policy Commission submits a report outlining principles adopted and general plan for developing all available resources to best serve all the communities.

One of the most interesting water supply problems on the Atlantic coast is that of furnishing potable water to the metropolitan district of northern New Jersey, which is approximately fifteen miles wide and forty-five miles long and contains a population of about three million, which is served by 34 water supply systems with about 280 m.g.d., of which 50 million gallons is from wells and the balance from surface supplies.

The surface supply available within the state is found in the hilly country extending for forty-five miles west of the district. This country is sparsely settled, and the water is of excellent quality. The Rockaway system, owned by Jersey City, furnishes 64 m.g.d.; the Pequannock, owned by Newark, 56.7 m.g.d.; the Passaic Consolidated Water Co., 58.7 m.g.d.; the balance being furnished by ten other companies and twenty-one municipalities.

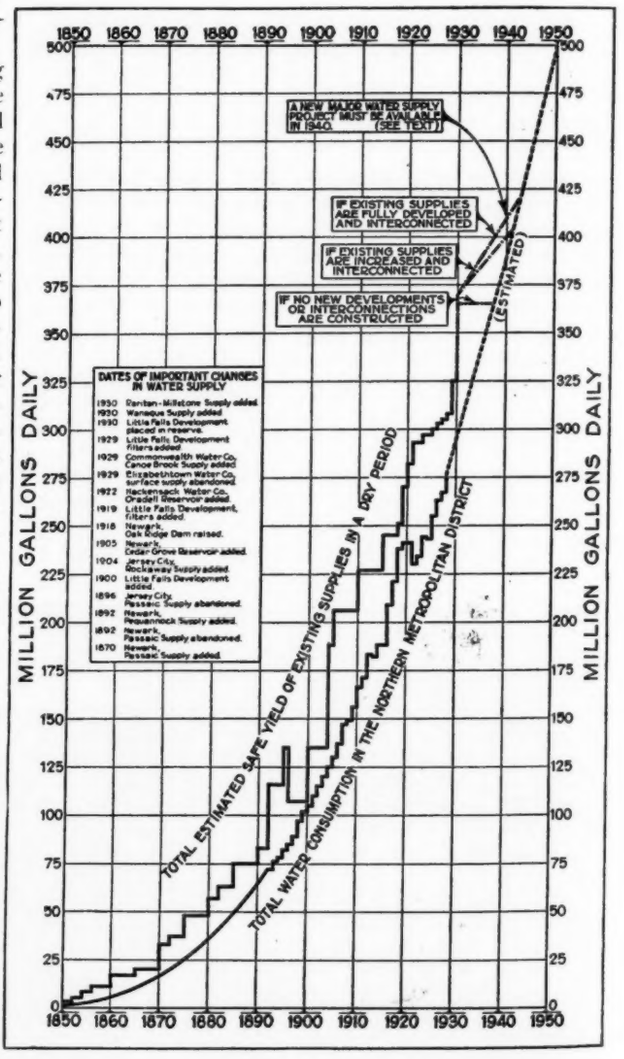
As in most cases where communities are growing rapidly, the several supplies have kept barely one jump ahead of the demand, and now most of them find the demand requiring an immediate increase in the supply. Heretofore the different communities and companies have acted independently, with the exception of the joint construction of the Wanaque project and a few cases of sale of water by one to another. But most of the more desirable near-by supplies have been developed and are being drawn upon almost to their limits; and further developments involve expenditures which the smaller communities can not meet.

The approach of this condition has been foreseen for years and efforts have been made to provide for meeting it. The State Dept. of Conservation and Development engaged Allen Hazen to report upon the needs and possibilities, and his report rendered in 1922 was abstracted in PUBLIC WORKS in April of that year. He found that, if fully developed within practicable limits, the available supply would meet the demand of the northern part of the state, for many years to come; which demand he estimated at 820 m.g.d. in 1970. His principal recommendation was a system having as its main feature an enormous reservoir south of Morristown, called Long Hill reservoir, with a maximum flow line at elevation 220, drawing its supply from all the streams to the northwest.

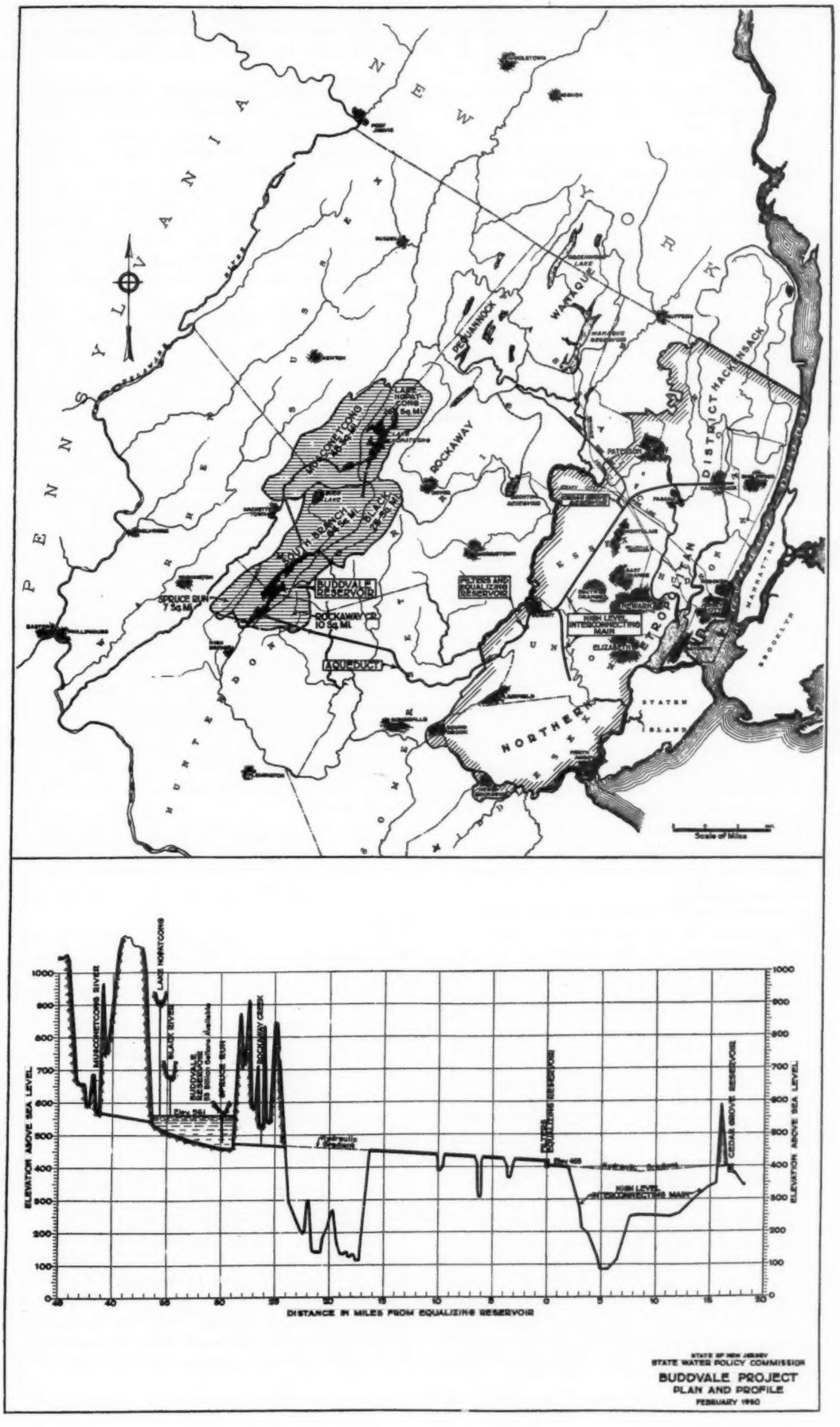
In 1925 Morris Sherrerd recommended the substitution for this reservoir of a much smaller one south of it, called Chimney Rock reservoir, with the same flow line elevation.

These and other engineers had shown that the solving of the problem was perfectly practicable from an engineering point of view, but it involved the expenditure of large sums and some manner of joint action by all the communities. An effort to provide for such joint action was made in the creation of the North Jersey District Water Supply Commission, through which eight municipalities have just completed the Wanaque reservoir and aqueduct, with an estimated capacity of 100 m.g.d.

However, no comprehensive plan covering the entire metropolitan district has yet been adopted, and the Water Supply Commission did not seem to be the most successful form of agency for carrying out such a plan. Therefore the 1929 State Legislature created a State Water Policy Commission to "continue and extend investigations of the water resources of the State, including the systematic gauging of rainfall and stream flow throughout the state, so as to complete a comprehensive study for the entire State, for the conservation, development, regulation and use of the waters in each of the principal watersheds of the State with reference to the accomplishment of the following public uses and purposes:


MILLION GALLONS DAILY
A NEW MAJOR WATER SUPPLY PROJECT MUST BE AVAILABLE IN 1940. (SEE TEXT)
IF EXISTING SUPPLIES ARE FULLY DEVELOPED AND INTERCONNECTED
IF EXISTING SUPPLIES ARE INCREASED AND INTERCONNECTED
IF NO NEW DEVELOPMENTS OR INTERCONNECTIONS ARE CONSTRUCTED
(ESTIMATED)
DATES OF IMPORTANT CHANGES IN WATER SUPPLY
1930 Raritan-Millstone Supply added.
1930 Wanaque Supply added.
1930 Little Falls Development placed in reserve.
1929 Little Falls Development, filters added.
1929 Commonwealth Water Co., Canoe Brook Supply added.
1929 Elizabethtown Water Co., surface supply abandoned.
1922 Hackensack Water Co., Oradell Reservoir added.
1919 Little Falls Development, filters added.
1918 Newark, Oak Ridge Dam raised.
1905 Newark, Cedar Grove Reservoir added.
1904 Jersey City, Rockaway Supply added.
1900 Little Falls Development added.
1896 Jersey City, Passaic Supply abandoned.
1892 Newark, Pequannock Supply added.
1892 Newark, Passaic Supply abandoned.
1870 Newark, Passaic Supply added.
TOTAL ESTIMATED SAFE YIELD OF EXISTING SUPPLIES IN A DRY PERIOD
TOTAL WATER CONSUMPTION IN THE NORTHERN METROPOLITAN DISTRICT
1850 1860 1870 1880 1890 1900 1910 1920 1930 1940 1950

Yield of Northern Metropolitan District Supplies and Total Consumption


PENNSYLVANIA
NEW YORK
ROCKAWAY
WANAQUE
DISTRICT
METROPOLITAN
NORTHERN
BUDDVALE RESERVOIR
EQUALIZING RESERVOIR
ROCKAWAY CR.
10 Sq. Mi.
SPRUCE RUN
7 Sq. Mi.
AQUEDUCT
HIGH LEVEL INTERCONNECTING MAIN
LAKE HOPATCONG
94 Sq. Mi.
DENVILLE RESERVOIR
CEDAR GROVE RESERVOIR
ELEVATION ABOVE SEA LEVEL
DISTANCE IN MILES FROM EQUALIZING RESERVOIR
STATE OF NEW JERSEY
STATE WATER POLICY COMMISSION
BUDDVALE PROJECT
PLAN AND PROFILE
FEBRUARY 1930

"(a) The supply of pure and wholesome water from watersheds to municipalities and the inhabitants thereof and the disposal of sewage and wastes which may affect the supply.

"(b) The prevention of floods. (c) Drainage and irrigation. (d) The conservation, development and utilization of water power. (e) The protection of public navigation."

The commission organized at once, and in view of its belief that additional supply for the northern metropolitan district by 1940 is imperative, it concentrated its immediate attention largely upon this subject; and in order that the present legislature might take preliminary action calculated to forward the development of such a plan, it made its first report to the legislature on March 3rd of this year.

This report is a notable step in the development of a comprehensive plan for utilizing the water supplies of the northern part of the state. Its outstanding feature is the division of the metropolitan district into zones according to elevation, and a corresponding division of the sources of supply so that all except the highest points can be served by gravity—something that previous reports had not considered. This includes existing as well as future supplies, some of the former having greater elevation than is needed for a considerable part of the areas they now serve, while other areas, which could be served by such supplies by gravity, find it necessary to pump the supplies which they use.

The zones proposed are a low-level; an intermediate zone with a delivery elevation of 230 feet; a high-level zone with a delivery elevation of 400 feet; and a special high-level, requiring pumping. It is proposed to use all of the present supplies, except the Pequannock, for the intermediate zone, although part of them is now pumped for parts of the high-level zone, there being enough supply now available for the intermediate zone for many years to come. The high-level zone would be supplied by new developments in the higher portions of the Raritan and Musconetcong watersheds, the reservoirs having elevations of 540 or more, or more than 200 feet higher than the reservoirs proposed in former plans. In addition, they would be further removed from centers of population and less liable to pollution.

In the few months which have passed since the commission was organized, it has not found it possible to reach definite conclusions on the details of the plan, such as the best locations for dams; but certain general principles have been decided upon; and it seems probable that one of three projects will prove the best, these being called the Ralston, Buddvale and Vernoy projects.

The Buddvale project is shown on the accompanying plan. It is based on a storage reservoir on the South Branch of the Raritan with a dam at Buddvale, about two miles below the village of Califon. Diversions from the Musconetcong, Black, Spruce Run and North Branch of Rockaway Creek, together with the 64 square miles of the South Branch itself, furnish the water for this project. The reservoir would occupy lands in parts of four townships and would obliterate there villages. A railroad traverses the entire length of the reservoir and 14 miles of expensive relocation would be required, as well as considerable highway relocation.

The total watershed area of the Buddvale project is 180 sq. mi. The total reservoir capacity is 55,000 million gallons, of which 53,000 million is available. The safe yield is estimated at 178 m.g.d. The flow line elevation is 561 and draft line 480. The estimated cost is $46,280,000, or $260,000 per m.g.d. safe yield.

The fundamental principles adopted by the commission as a basis for its program and plan are as follows:

1. The principal water supplies of the Northern Metropolitan District eventually will be operated as a unit, through some co-ordinating agency.

2. Operation will be at cost, due allowance being made for elevation and location of various consumers.

3. Smaller municipalities having local supplies will retain ownership and operation there of, but extensions of such supplies where located outside the municipalities will not be encouraged unless connection to a major supply is unduly expensive.

4. Future water supplies will be planned and constructed by such an agency when and as needed to provide adequately for the growing needs of the district as a whole.

5. All major existing supplies and new supplies as constructed will be interconnected by connections of adequate size, so located as to make operation flexible and economical.

6. The district eventually will be divided into service zones. Each zone, except the highest, which will of necessity be supplied by pumping, will be supplied from two or more gravity supplies. Each portion of the area will be served from the supply or supplies best adapted for its use, and each locality will have service available from at least two sources.

Among the conclusions given in the report are the following:

The principle of joint use and joint ownership of water supplies is established. The further steps of joint ownership by all municipalities of all the principal water supplies of the district, and of pooling the water supplies themselves, are logical and practicable and all future water supply legislation and construction should be developed to that end.

The next major water supply project should be a high level development of appropriate size and elevation to provide, in conjunction with the Pequannock supply of Newark, for the demands of the High Service Zone for many years.

Such a high level project should be made available, by means of a connecting aqueduct, to the entire High Service Zone and to as much of the Intermediate Service Zone as is not adequately and more economically served by existing low level supplies.

Future lower level supplies should be planned and constructed to co-ordinate, by means of interconnections and interconnecting aqueducts, with the high level supply next to be built and with existing lower level supplies.

Among the recommendations made by the commission are the following:

That the studies of the three suggested high level projects be continued in order to determine definitely the most advisable solution.

That portions of the proposed high level interconnecting mains be constructed as part of the project, in order to make the supply available to all parts of the district through existing transmission mains.

That the principle of co-ordination of all major existing and future supplies be recognized as equal in importance and urgency to the construction of a new supply.

That in advance of legislation facilitating or requiring such co-operation, effort be continued to carry out the recommended construction by voluntary co-operation of interested municipalities.

That grants for future major supplies be restricted so as to provide for recapture at cost by such State or district agency as may eventually be authorized to co-ordinate the operation of the major supplies of the district.

The State Water Policy Commission consists of Willard J. Hamilton, chairman; Cornelius Doremus, F. Morse Archer, Max Grossman, Thurlow C. Nelson, Henry G. Parker and Owen J. Prior. Morris R. Sherrerd is chief engineer; Arthur L. Sherman, deputy chief engineer; Charles F. Breitzke, research engineer; and John Wyack, secretary to chief engineer.

RECENT LEGAL DECISIONS

CONSTRUCTION OF SEWER CONSTRUCTION CONTRACT PROVISION AS TO TEMPORARY SHEATHING.

Where a sewer construction contract contained a declaration by the contractor that he had examined the site of the work and had informed himself fully as to all the conditions pertaining to the place where the work was to be done and satisfied himself as to all matters relating to the work, he was presumed to have known the depth of excavations required and the fact that a gas main was located on the street and in close proximity to the sewer line to be excavated.

The contract provided that the contractor should, at his expense, properly support the trenches by sheathing or bracing when necessary in the opinion of the engineers, of a thickness demanded by the existing conditions. It was held that the contractor was required to provide at his expense a 4-inch temporary sheathing when ordered by the engineers. The engineers might thereafter order in writing that the temporary sheathing be left in place, the contractor to cut off the tops above the ground, to be paid by the municipality at the price stated in the contractor's proposal. It was held that an order obtained from the engineers in advance of the excavation to use 4-inch sheathing to be left permanently in the trenches was in violation of the contract and an attempt to place the cost of the temporary sheathing upon the town, which had a right to have it rescinded without being liable for breach of the contract. Terrill Const. Co. v. Town of Pineville, 168 La. 894, 123 So. 611.

INJUNCTION ALLOWED OF FIRE ENGINE HOUSE ON PARK LANDS.

There is a well-established distinction between the dedication of a street to the public use and the dedication of a park or common to such use. When land is dedicated for a public park by the municipality, it inures to the benefit of all its citizens. It is held in trust for the benefit of the public, without power to convey or divert to other uses. The property owners were held entitled to enjoin the commissioners of the District of Columbia from establishing a fire engine house on land condemned for a park, a fire engine house not being such an agency that the protection and safety afforded is dependent upon its locality at any particular point. Quinn v. Dougherty, App. D. C., 30 F. (2d) 749.

The court cited Douglass v. City of Montgomery, 118 Ala. 599, holding that one who can look from the front of his house with an unobstructed view upon a park nearby can maintain injunction to restrain the diversion of the use of the park from the purpose for which it was dedicated, in this case by the construction of a railroad track across the park, although he may not be an abutting owner.

ABUTTING OWNER WHO DELAYS OBJECTING TO PAVING CANNOT ON COMPLETION OBJECT TO ASSESSMENT.

The Georgia Court of Appeals holds, City of Marietta v. Kile, 149 S. E. 54, that where a municipal corporation has jurisdiction to pave its streets and assess the cost thereof against the owners of abutting property, such owners will be estopped from asserting that the paving was not done in compliance with the provisions of the paving ordinance if they stand by and permit the work to be done without interposing any objection until after the completion of the work and its acceptance by the city authorities. Therefore, where the affidavit of illegality by an abutting owner, alleging that the assessing ordinance was null and void because the paving was not completed in accordance with the provisions of the paving ordinance, as required by statute, showed that the affiant knew that the paving was being improperly done, and that he stood by and permitted the city to finish paving the street, without making any objection until after completion and acceptance of the work, he was estopped from subsequently objecting to the way in which the street was paved, or from questioning the validity of the assessing ordinance, although his affidavit recited that "a number of property owners" did object to the way in which the street was being paved, but failed to state that he was one of them.

PROVISION FOR WRITTEN AUTHORITY FOR EXTRAS MAY BE WAIVED BY PARTIES.

It does not follow, from the fact that a construction or excavation contract provides only for extras by written consent and approval of the architect in charge, that the parties may not, for reasons satisfactory to themselves, waive or modify their undertaking. It was so held in an action by a subcontractor for excavation work against the general contractor, for compensation for extra work, Teer v. George A. Fuller Co., C. C. A., 4th circuit, 30 F (2d) 30. One of the cases cited was Wyandotte, etc., Ry. Co. v. King Bridge Co., C. C. A., 100 F. 197, where it was decided that a provision in a contract to build a bridge according to plans and specifications, which states that no extra labor or material shall be paid for unless agreed to in writing, does not deprive the contractor of the right to recover for additional work or material furnished outside of the contract at the request of the owner though not agreed upon in writing.

ROAD CONSTRUCTION CONTRACTOR'S RIGHT TO RECOVER UNDER SUBCONTRACTOR'S BOND.

Highway construction contractors sublet the work for 87½ per cent of the original contract price. The subcontractors furnished a bond. The work was abandoned, and completed by the surety. The original contractors sued the surety for the 12½ per cent of the contract price reserved, and certain payments for and advances to the subcontractor. The surety contended that in the performance of the contract it had expended more than the penalty of the bond. It was held that the contractors could recover where the defendant failed to prove that the money was prudently and necessarily expended under competent supervision. Federal Surety Co. v. Lalonde, C. C. A., 31 F (2d) 673.

CITY'S WATERWORKS DEPARTMENT HELD A NON-GOVERNMENTAL BUSINESS.

The Georgia Court of Appeals, City of Rome v. Justice, 149 S. E. 88, holds, in an action against a city for personal injuries sustained by plaintiff in a collision between a wagon in which he was riding and a truck used in connection with the city's waterworks department that, under the rule in force in Georgia,

a municipality, in maintaining and operating a system of waterworks whereby it furnishes water to its residents for domestic and commercial purposes, is engaged in a private, nongovernmental business, and is liable to one injured by the negligence of an employee acting within the scope of his employment in connection with such business; and this is true notwithstanding the charter of the city directs that the price of the water so furnished shall be fixed as nearly as possible at "the cost of said water to the city."

CHARTER PROVISION AS TO INITIATING AND CARRYING OUT STREET IMPROVEMENTS.

The Oklahoma Supreme Court, Ponca City v. Edwards, 280 Pac. 445, holds that section 101 of the Charter of Ponca City, when read and construed in its entirety, creates a majority of property owners in a proposed street improvement district the final arbiters as to whether such improvements shall be made. But when such property owners act on their own initiative under the charter and present a sufficient petition praying for a street improvement district and naming the kind of material to be used in the construction of the streets therein, it thereupon becomes the duty of the board of commissioners of the city to cause the improvements to be made in accordance with the petition.

IMPLIED POWER OF STATE HIGHWAY COMMITTEE TO EMPLOY CONSULTING ENGINEER.

The Washington Supreme Court holds, State v. Clausen, 272 Pac. 22, that under a statute (Rem. Comp. Stat. § 6763) expressly making it the duty of the state highway committee to determine the feasibility of a proposed state road and to approve outline and profile maps and plans and specifications, the committee has the implied power to employ a consulting engineer to advise the members with reference to the feasibility of state roads and the plans and specifications thereof prepared by the highway engineer and submitted to the committee for its approval.

POWERS OF TOWNSHIP BOARDS OF HEALTH UNDER NORTH DAKOTA STATUTE.

The North Dakota Supreme Court holds, State v. Moher, 224 N. W. 890, that, under the provisions of section 4176, C. L. 1913, township boards of health may make only temporary regulations respecting matters of sanitation, and a general regulation of such a board prohibiting the dumping of garbage at any place within the township at any time by any person is permanent and general in its nature and as such clearly beyond the power of the board to enact.

CITY'S RIGHT TO CHANGE SOURCE OF PAYMENT FOR LOCAL IMPROVEMENT.

The Washington Supreme Court holds, Clise v. City of Seattle, 280 Pac. 80, that a city had a right to abandon a local improvement, the grading and paving of a street, which had been initiated under a special assessment plan, and could complete it from the general fund, or in any other way that it saw fit, as provided under the charter.

REMEDY AGAINST VOID ASSESSMENTS IN MINNESOTA.

Injunction does not lie in Minnesota against a municipality and its officers to restrain the enforcement of special assessments after they are certified to the county auditor for extension on the tax list. If such assessments are wholly void for want of notice, there is an adequate remedy at law in the proceeding for the enforcement of delinquent taxes and assessments in the district court.—Schultz v. City of North Mankato, 176 Minn. 76, 222 N. W. 518.

MAINTENANCE OF NATURAL PASSAGEWAY FOR WATER UNDER BRIDGES AND OTHER STRUCTURES.

It is the duty of those who build structures across natural drainways to provide for the natural passage through such obstructions of all waters which may be reasonably anticipated to drain there, and this is a continuing duty.—Crummel v. Nemaha County, Nebraska Supreme Court, 224 N. W. 864.

SUFFICIENCY OF PETITION FOR AMOUNT DUE UNDER ROAD CONSTRUCTION CONTRACT

In an action for the contract price of construction of a public road, defense was made that, as the contract did not call for a fixed price, but the price was dependent upon the quantity of work, it was essential, to state a cause of action, that plaintiff should have alleged what work had been done and the price. There was, however, attached to the contract an estimate of the work undertaken, on which the contractor based his bid, and the aggregate amount to be paid for the work, based upon the estimate, was the amount claimed to be due by the plaintiff. The Louisiana Court of Appeal therefore held, Childers v. Police Jury of Parish of Ouachita, 121 So. 248, that plaintiff could under his pleading introduce evidence to show that the work called for under the estimate had been done, and that it was due and unpaid, and the exception of no cause of action should have been overruled.

CONTRACT FOR WORKING DIRT ROADS HELD INVALID BECAUSE ADVERTISEMENT FOR BIDS NOT SHOWN IN MINUTES

The Mississippi Supreme Court holds, Russell v. Copiah County, 121 So. 133, that a contract for working and maintaining the dirt roads of a district of the county was void under Miss. Code 1906, § 369, where the minutes of the board of supervisors did not show an adjudication that advertisement for bids had been made in the manner provided by sections 361, 4441. Prior payments by the board to the contractor for work done under the void contract would not constitute a ratification of the contract, so as to enable the contractor to recover thereunder.

INJUNCTION OF CONSTRUCTION OF BRIDGE BECAUSE OF ANTICIPATED INJURY REFUSED.

The North Carolina Supreme Court holds, Town of Greenville v. State Highway Commission, 196 N. C. 226, 145 S. E. 31, that an injunction restraining the commission from constructing a bridge would not be granted on the ground that it would injure the town's water and power plant and flood the lands of certain owners of property, the defendant being engaged in a public enterprise and the plaintiffs having ample redress under the law of eminent domain and C. S. Supp. 1924, § 3846 (bb), and also because the anticipated injury was contingent, and the court will not act upon speculative proof or such as furnishes ground only for conjecture. The defendant conceded that the ponding of water on lands belonging to the plaintiffs would be a taking for a public use within the law of eminent domain, and that the plaintiff upon sufficient proof would be entitled to a recovery at their election of permanent damages.

Engineering Societies

May 10—NEW YORK STATE SEWAGE WORKS ASS'N. Earl Devendorf, 23 South Pearl St., Albany, N. Y.

June 2-6—AMERICAN WATER WORKS ASS'N. Annual convention at St. Louis, Mo. Beekman C. Little, Secy., 29 West 39th St., New York.

June 23-25—NATIONAL CONFERENCE ON CITY PLANNING. Annual conference at Denver, Colo. Secretary, Flavel Shurtleff, 130 East 22nd Street, New York.

September 24-27—INTERNATIONAL CITY MANAGERS' ASSOCIATION. Annual meeting at San Francisco, Calif. Executive Secretary, Clarence E. Ridley, 923 East 60th Street, Chicago, Ill.

October 13-17—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual meeting at Richmond, Va. Secretary, C. W. S. Sammelman, 315 Commercial Building, St. Louis, Mo.

October 27-31—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting at Fort Worth, Texas. Executive Secretary, Homer N. Calver, 370 Seventh Avenue, New York.

American Water Works Association

The goal set by Arthur E. Gorman, Chairman of the 1930 Membership Committee of the AWWA, is five hundred new members before the St. Louis Convention.

The campaign in its first stage was launched with an appeal to the entire membership of AWWA for assistance in furnishing a list of "live" prospects. The returns were most encouraging and indicate a wide interest in the campaign by the membership. Many cards have been returned to the committee recommending more than 2000 prospects for membership.

The campaign will be carried out along two major lines: 1. Personal solicitation; 2. Direct mail.

The direct mail campaign to prospects will consist of five mailings concluding two weeks before the St. Louis convention. Through section committees it is planned to solicit personally every prospect on the list, the direct mail campaign being depended on to create interest in the association and assist in the membership drive.

Asphalt Institute

The newly organized Asphalt Institute, which succeeded The Asphalt Association on January 1, last, has elected the following officers for the fiscal year 1930: Leroy M. Law, St. Louis, Mo., president; W. H. Kershaw, New York, N. Y., vice-president; C. W. Bayliss, Philadelphia, Pa., vice-president; B. L. Boye, New York, N. Y., secretary, and Fisher Jones, New York, N. Y., treasurer. J. S. Helm of New York is chairman of the Executive Committee and J. E. Pennybacker, also of New York is managing director.

On or about April 15, the Institute will move to the new Crystal Building, 250 East Forty-third Street and 801 Second Avenue, New York, where it has leased, for five years, the entire eighteenth floor. Larger general offices, and a new and larger laboratory will be installed in these quarters with F. C. Field, assistant chemical engineer, in charge. The entire research division will be under the supervision and direction of the Institute's chemical engineer Prevost Hubbard, formerly chief of research for the United States Bureau of Roads.

In its new quarters the Institute will occupy more than twice its present amount of floor space. The personnel is to be expanded and the activities of the Institute extended to cover education and research in the use of asphalt for roofing, insulating and water-proofing as well as paving.

B. E. Gray, formerly of the West Virginia State Highway Department and the United States Bureau of Public Roads, becomes director of the highway engineering division, succeeding W. E. Rosengarten who resigned recently to accept a position with Day & Zimmerman in Philadelphia. Mr. Gray, who is widely known among the highway engineers of the country, entered upon his new duties March 20, last. A new man also has been added to the laboratory staff, in Henry Krieger who becomes assistant to Mr. Field.

The probabilities are that the Ninth Annual Asphalt Paving Conference to be held under the auspices of the Asphalt Institute, will be held in October 1930, at Washington, D. C., just preceding the International Road Congress and simultaneous with conventions of other organizations identified with the road-building industry.

New Jersey Sewage Works Association.

The Fifteenth annual meeting of the New Jersey Sewage Works Association was held at Trenton, N. J., March 21 and 22. The attendance was unusually large. Between 150 and 200 from New York, New Jersey, Pennsylvania, Maryland, and Ohio were present.

The program was full, but despite a rather late start, was kept pretty well to schedule. Discussions were numerous and interesting. The meeting opened with a description by H. Burdett Cleveland of the new sewage treatment plant at Rumson, N. J. He was followed by C. C. Hommon, superintendent of the Canton, Ohio, plant, who spoke on plant experience, discussing mostly trickling filter experiences. F. M. Veatch told of some interesting points in design and operation of western and southwestern plants. Edward F. Shissler described very briefly the operating experience with the glass covered sprinkling filters at Haddon Heights, N. J.

Major M. J. Blew opened the afternoon session with a description of results obtained at the Philadelphia experimental plant, devoting most of his speech to the activated sludge method. Following this were two papers by Lester Smith and Dr. Ginsberg and Leroy Forman of mosquito breeding in catch basins, cesspools and sewage treatment plants. Elmer App and J. B. Baty of the New Jersey Department of Health discussed detention periods in settling tanks; Chester Wigley described a new method of drying green sludge for fer-

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tilizer, and H. Heukelekian presented a paper on "Thermophilic Digestion." Following this was the report of Dr. Rudolfs on research work for 1929, and round table discussion. A "speechless dinner" was held in the evening at which some of the members distinguished themselves with new stories.

The Camden operators' school and the Rutgers short course were described at the Saturday morning meeting, after which were two papers: Drying Sludge Under Glass, by Floyd G. Browne of Marion, Ohio, and The Operation of the Glassboro Plant, by C. H. Shute.

American Road Builders' Association

A delegation of more than 125 highway engineers and road building executives will journey to Mexico City in April to attend the third highway congress of the Mexican national highway commission.

Maj. Frederic A. Reimer, president, and Charles M. Upham, engineer-director of the American Road Builders' Association, will be joined by the association's executive committee in forming a party to leave Washington, April 15, in special cars direct to the Mexican capital. This group will be joined at Chicago, St. Louis and way points by several score members. They will travel by way of San Antonio and Laredo, Texas, and Monterey, Mexico. Reduced railroad fares will be in effect from all points in the United States to Mexico City and returning.

They will be received by Mexico's president, Senor Ortiz Rubio, and his cabinet and attend a rodeo and other open air events. Side trips to many points of romantic and historic interest have been arranged.

Many American manufacturers will send machinery and pictorial exhibits for the exposition, which will be staged in the huge national stadium. The enthusiasm throughout Latin America for road building is exemplified in Mexico where highway systems now under way will reach all parts of the nation.

The congress expects to form a permanent committee to coordinate the road building activities of all the Mexican states with the federal program.

Personals

H. S. Ale, of Altoona, Pa., has been selected as superintendent of the city water bureau of that city.

D. L. Hogan has been appointed county engineer for Van Zandt County, Texas.

Henry Canty has been appointed county engineer of Mason County, Wash., succeeding W. H. Wiley, resigned.

William G. Hudson has been appointed district engineer of the Portland Cement Association, in charge of work in Louisiana and Mississippi. He will have offices in the Hibernia Bank Bldg., New Orleans, La.

J. Frederick Jackson of New Haven, Conn., has been elected an honorary member of the Connecticut Society of Civil Engineers.

W. N. Frickstead has been appointed city engineer of Oakland, Calif.

W. J. B. Smith, of Dayton, Wash., has been appointed county engineer of Franklin County, Wash.

The Central Foundry Company announces the appointment of Leonard W. Saine as General Manager of Sales for Universal Pipe Division. Mr. Saine, who was the Company's representative in the South for a number of years, succeeds Robert W. Conrow. Mr. Saine will make his headquarters at the general offices of the Central Foundry Company, Graybar Building, Lexington avenue and 43rd Street, New York.

New appointments in the Universal Atlas Cement company, a subsidiary of the United States Steel corporation, have been announced as follows:

E. D. Barry, superintendent of the plant at Universal, Pa., is appointed assistant operating manager with offices in Chicago. Mr. Barry is a graduate of the Massachusetts Institute of Technology. He has been connected with Universal for more than 25 years.

Leonard Wesson, assistant general superintendent, Atlas division, is appointed assistant operating manager with headquarters in Chicago. In his new position Mr. Wesson will return to familiar ground as he was formerly a member of the Universal organization. He has had more than 20 years' experience in the cement industry.

J. C. Witt, chemical engineer, is transferred from the Buffington, Ind., plant to Chicago. He is a graduate of Butler college, of the University of Chicago and of the University of Pittsburgh, taking his doctor of philosophy degree at the latter institution. For three years he was engaged in chemical research for the Portland Cement association and is the author of many articles on the subject. Mr. Witt has been with Universal since 1924.

T. A. Hicks, general chemist, Atlas division, is appointed to the same position with the new company, with offices in Chicago. For many years Mr. Hicks was associated with the Atlas company and has high standing in the technical and engineering world.

R. L. Slocum, who hitherto was assistant superintendent at the Universal, Pa., plant is made superintendent. He is a graduate of Pennsylvania State college and was connected with the Carnegie Steel company, another subsidiary of the Steel corporation, until he came to Universal. Last year he was awarded the Judge Gary medal for 25 years' continuous service.

H. H. Lauer, engineer, Atlas division, who is appointed assistant chief engineer, Chicago, has been with the Atlas company several years. Previously he was connected with the Illinois Steel company and related industries and has had extensive experience in the engineering field.

Clemens Herschel, 88 years old, past-president of the American Society of Civil Engineers and long recognized as a leading hydraulic engineer, died March 1 at his home in Glen Ridge, N. J.

Trade Publications

Pump-Fax.—This valuable handbook on pumping has been published by Goulds Pumps, Inc., Seneca Falls, N. Y. In its 64 pages will be found data which will be a great help to the man who has the problem of moving liquids of any kind: water, oil, chemicals, or any liquid products in manufacturing processes. Indeed, this problem is sure to be found in practically every industry. Information on pumps and pumping, gained through experience of over eighty years of pump manufacture, is here made available by Goulds Pumps in the hope that it may be useful to its friends. This bulletin describes in a simple way why pumps work and gives information about the characteristics, installation and operation of the three important types of pumps as manufactured by Goulds. From such data as this, the buyer, himself, can often select the pump for his job and can surely understand the recommendations of the pump engineers. In addition, much will be found that will help in the selection and location of the piping, valves and other accessories which will lead to a first class installation at a reasonable cost. This compilation was made by Prof. F. G. Switzer of Cornell University.

Airport Drainage.—The various angles of the subject of airport drainage are discussed in Bulletin C-2, "Building Safety Into Airports—with Efficient Drainage Construction," which has just been published by the Armco Culvert Mfrs. Association, Middletown, Ohio. This well illustrated bulletin is, in addition, filled with information and suggestions of great value to those who are responsible for the design or construction of drainage systems for airports. Copies may be obtained on request.

Blaw-Knox Steel Forms.—One of the most complete catalogs that has come to this office is the 112-page Blaw-Knox steel form book. This gives a very complete story of the various uses of forms for every kind of construction work; it constitutes, in fact, a review of progress in concrete construction. Illustrations, text and explanatory legends carry a very full story of form use. Owing to the cost of this book, which is 8½x11, on coated paper, and very fully illustrated, it will be sent to contractors and engineers who write for a copy, using their letterheads.

Cletracs.—The Cleveland Tractor Co., Cleveland, O., has brought out a portfolio covering the entire Cletrac line, which now includes tractors for all kinds of industrial and agricultural work.

Bit-u-muls

"HEAVY TRAFFIC"
Pavement
at "LIGHT TRAFFIC"
Costs

A revolutionary development in paving

After years of extensive research . . . its quality proved, by widespread use throughout the world . . . Bitumuls now offers the demonstrated answer to the public's demand for more roads.

Combining the meritorious features of the two well-known hot asphaltic types . . . Bitumuls construction results in durable, non-skid, water-proof, rock pavements . . . *with no heating costs whatever.*

Voids are reduced to a minimum. And, because the use of excess asphalt is eliminated, there is no shoving and surface bleeding.

Easy to Lay

Only simple equipment required to construct. Application may be with the popular types of gravity or pressure distributors, or with ordinary pouring pots.

Applied at any atmospheric temperature, except freezing weather . . . and in damp, or even mildly rainy weather . . . Bitumuls non-skid paving adds many months to your construction season.

To get more miles from your paving dollars . . . on secondary roads, primary roads, city streets, subdivisions, widening, resurfacing, maintenance, and airports . . . investigate Bitumuls low-cost construction.

Be sure that your specifications measure up to Bitumuls. It is unadulterated . . . 99½% pure.

Mail the coupon for manual, with detailed facts, technical data, and specifications.

Make This Practical Test

Order a sufficient number of barrels of Bitumuls to make a thorough test. Have your regular paving crews apply it . . . in small areas . . . with ordinary gravity or pressure distributors, or with pouring pots. See for yourself the amazing possibilities of Bitumuls in your pavement construction and maintenance . . . its low cost . . . its durability . . . its non-skid surface.

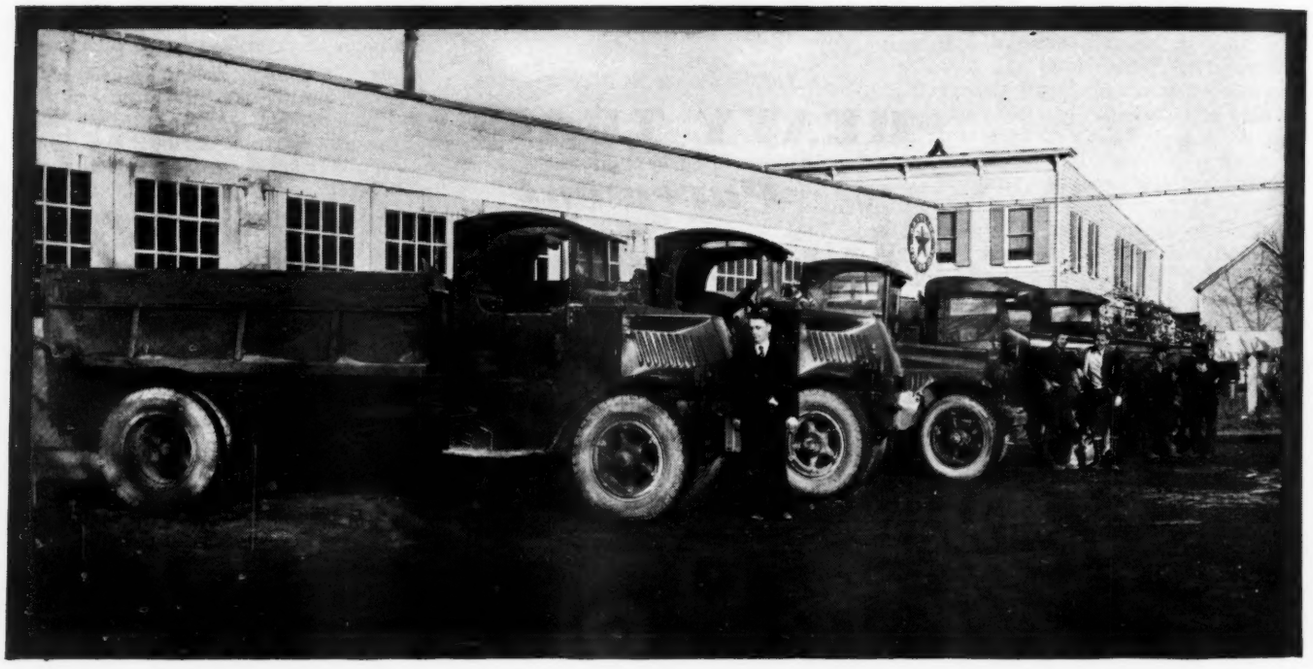
AMERICAN BITUMULS COMPANY—Branches throughout the world

In the East write to: 4200 O'Donnell St., Baltimore. In the West write to: 503 Market Street, San Francisco.

Please mail me your free manual . . . without obligation

Name_____ **Address**_____

MORE THAN AVERAGE AVERAGE



The tires on Mr. Paul Hidden's large fleet of trucks are naturally subjected to more than average abuse. Yet, in spite of these severe conditions, Goodrich Heavy Duty Silvertowns are setting new records for economy.

HERE'S a true story—unsolicited, outlining actual facts that sum up typical Goodrich performance in a few words.

Mr. Paul Hidden, owner and operator of a fleet of trucks for heavy hauling, says, "... Goodrich Tires have given me finer service than any other tires I have ever used."

Dump-truck service — as tough a test as tires can get. Down into rough excavations ... beside steam shovels ... up the steep grades ... over winter's frozen roads and through spring's sticky mud. Fast runs on boulevards and slow going through rutted alleys...all in a day's work for dump trucks.

Abuse aplenty...sometimes careless driving, possible underinflation, speed, load,

Goodrich HEAVY DUTY

SPECIFY GOODRICH

For latest catalogs—the *classified* INDUSTRIAL LITERATURE section, pages 79 to 86.

ABUSE · BETTER THAN SERVICE

Goodrich *Heavy Duty* Silvertowns *on P. Hidden Transfer Trucks, Baltimore County, Maryland, Make Long Service Record Under Abnormally Severe Conditions*

Heavy Duty Silvertowns on the big Silver Fleet Truck pictured above more than proved their added stamina and endurance throughout this recent 30,000 mile trans-continental grind.

•

cuts, bruises...all these conditions give tires a test that can't be exceeded for severity. They alone estimate a product's worth.

But Goodrich quality proves itself again and again . . . and fleet owners don't hesitate to give credit where credit is earned.

More than average abuse . . . better than average service. This is the story that is reported by truck operators everywhere. For everywhere Goodrich Tires are doing the *job* . . . and doing the job exceedingly well.

• • •

The B. F. Goodrich Rubber Company, Est. 1870, Akron, Ohio — Pacific Goodrich Rubber Co., Los Angeles, Calif. In Canada: Canadian Goodrich Co., Kitchener, Ont.

Silvertowns

ON YOUR NEW TRUCKS

Engineering and Construction Equipment

New Machinery, Apparatus, Materials and Methods and Recent Installations.

The New Cletrac Model 80-60 Tractor

The specifications of the new Cletrac Model 80-60 tractor recently brought out by the Cleveland Tractor Co., Cleveland, O., include the following.

Total weight, 20,250 pounds; overall width, 96 inches; overall length, 156 inches; overall height from ground to top of radiator, 82 inches; ground clearance between the lowest part of drawbar and ground, 15 inches without grousers; with grousers, 18 inches; tread of tracks (center to center) 67 inches; width of tracks, 17 inches; track length (ground contact), 97 inches, giving a ground contact of 33 per cent of the total length of track.

The motor is 6-cylinder, 119 brake horse power, 927 cubic inch displacement. It is equipped with 12-volt Delco-Remy starting and lighting and single ignition, also Purolator oil cleaner and an A C Breather. Four-bearing crank shaft 3¼ inches in diameter by 3¼ inches long. The clutch is Borg and Beck, 18 inch pull type.

The transmission is of the selective type, three speeds forward and one reverse. At 1,050 governed motor speed, the tractor speed is 1¾ miles per hour low gear, 2½ miles per hour intermediate gear, 3.6 miles per hour high gear and 2.1 miles per hour in reverse.

The front wheel is constructed with a two-shaft construction which keeps the wheels in line both vertically and horizontally at all times.

New Model 1¼-Yard Speeder Shovel

The Speeder Machinery Corporation, Cedar Rapids, Ia., has brought out the Speeder Model 90 Shovel of 1¼ yards capacity.

The Speeder Model 90 is the result of five years study by Speeder engineers. Some of its features are: Timken bearing unit built and friction free throughout; automotive construction; all shafting heat treated and ground to micrometer limits in size; all shafts and hubs splined at important points; all gears, including all bevels and the ring or "bull" gear are cast from special composition steels and machine cut from solid blanks to a mirror finish. All bevel gears are heat treated and hardened, and the traction bevels run in oil in an oil tight cast case; the unit construction allows the drum shafts, vertical shafts, etc., to be removed intact, including bearings, as a unit, thus allowing all repairs and adjustments to be made in the shop on the bench; and also allows bearing adjustments to be made without removing the shafts from the machine.

Descriptions and catalogs of the equipment on this and the following pages may be obtained from Public Works by using the form on page 79

Speeder Model 90, like all other Speeder shovels, has two working speeds on all operations, drums, travel, and swing. Both speeds are direct drives from the power unit and are both actual operating speeds; one, the high speed for shovel work; and the medium speed for crane or dragline work. All drive shafts run at relatively high speeds, thus eliminating the tremendous pressures ordinarily put on shafts, gears, bearings, and clutches, and also eliminates the need for coarse, heavy gears and clumsy shafting. The lower frame is a steel casting with machined track with semi-tubular side members closed at the top to exclude dirt. The treads are of extra length, being 14 feet 6 inches overall. The turntable is 6 feet 3 inches in diameter, and renewable.

Outstanding features of the Speeder Model 90, other than speed and power, are an automatic swing and travel brake, backgeared and purely automatic. It engages as soon as the swing or travel clutches are released, thus eliminating the burning of reverse clutches.

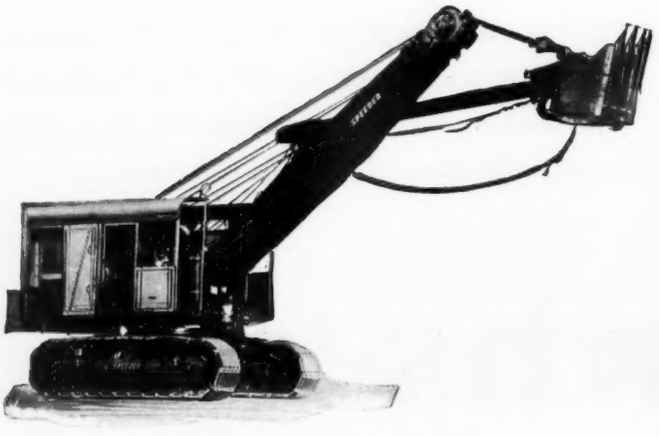
The patented Speeder reversible drum cable crowd is used. An automatic power trip for the bucket can be released by light pressure and its action is as fast. There is no waiting for a clutch to wind up loose cables.

The rear counterweight is instantly adjustable which provides correct ballast for long boom work and gives an adjustable tail swing. The machine has a ground clearance of seventeen inches yet it is only eleven feet high from ground to top of cab.

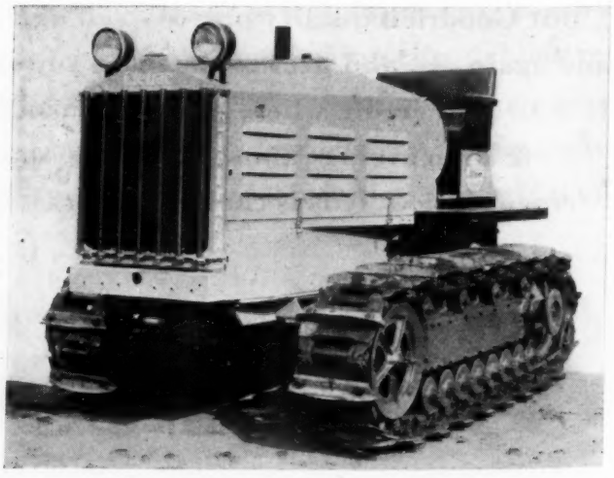
Speeder Model 90 is powered by gasoline, electric, or Diesel power and weighs approximately 40 tons.

New Four Wheel Drive 2½-Ton Truck

The Four Wheel Drive Auto Company, Clintonville, Wisconsin, announces a 2½-ton capacity, four wheel driven truck; it is designated as Model HH-6. The truck is powered by a six-cylindered motor of 67 brake horse power. This engine is of the seven bearing crankshaft type, with a bore and stroke of 3¾ by 4¾ inches respectively, giving a piston displacement of 315 cubic inches. The cylinders are cast enbloc. with a removable ricardo head. An improved feature is the installation as standard equipment, of the Blue Flame manifold, designed to intensify the explosion power within the cylinders. The

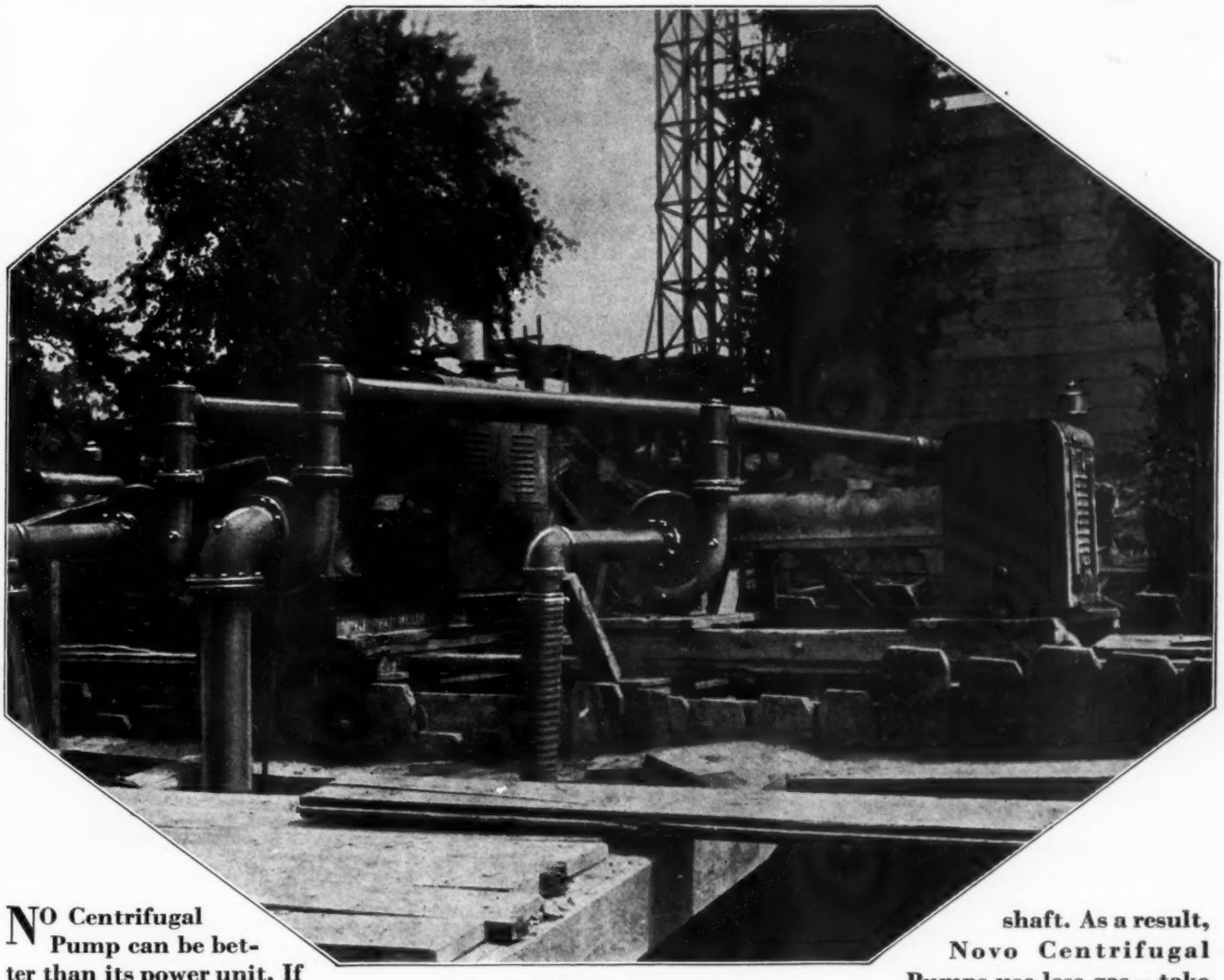


Speeder New 1¼-Yard Shovel



New Cletrac 80-60 Model Tractor

Give the Engine Its Due When Buying Centrifugal Pumps



NO Centrifugal Pump can be better than its power unit. If the engine fails, the pump stops. And the engine is the biggest factor in high or low operating costs.

That's why Novo Direct Connected Centrifugal Pumps have a big lead over the field. They are the only Centrifugal Pumps powered with the famous Novo Rollr Engines—with Timken Roller Bearings on the crank shaft and drive shaft. As a result, Novo Centrifugal Pumps use less gas—take only a quarter turn right hand crank to start—are vibrationless in operation, compact, overpowered and require only a minimum of attention.

In addition, the electric welded tubular constructed frames provide far greater strength and rigidity—at the same time eliminating much unnecessary weight.

Tennessee River job at Knoxville, known as the Cherokee Bridge, on which twelve Novo outfits—pumps and hoists —are trimming costs to the core

The Novo Pumping Handbook is helping many contractors to lower their water handling costs. It covers all types of pumping jobs—with Pressure, Diaphragm and Centrifugal Pumps. Send the coupon for your copy

NOVO
PUMPS—ENGINES—HOISTS

Please send me the Novo Pumping Handbook.

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NOVO ENGINE COMPANY
244 Porter Street, Lansing, Michigan
Clarence E. Bement, Vice-Pres. and Gen. Mgr.

This new F W D Truck has a capacity of 2½ tons, and is equipped with many improvements

oil is forced from a special base, designed to keep the oil surface level under all road conditions, through a complete oil filter equipment. A vacuum tank is used to supply the Zenith carburetor from the big capacity gas tank under the driver's seat.

The clutch is of the dry multiple disc type with eight drive and eight driven discs, especially designed to prevent slipping or grabbing. The seven speed transmission, placed amidships, is the equivalent of two four speed transmissions, one of them direct in fourth speed and with low low-speed for usual road and grade conditions, and the other direct in third speed, over-drive in fourth that provides for fast traveling.

Two systems of brakes, independent of each other, contribute absolute driving safety. The four wheel, or service brake, located on the rear of the sub-transmission, is of the contracting type and exerts its force to all four driving wheels. The emergency, or hand brake, of the internal expansion toggle type, operates on 18-inch rear wheel drums. A breakage in either system leaves the other functionable, and minimizes brake heating probabilities.

Improvements in Asphalt Kettle Construction

Littleford Bros., manufacturers of the LB line of Road Maintenance Equipment, announce No. 84-HD, a tar and asphalt kettle entirely new in design. It is claimed that asphalt can be drawn from the melting tank almost immediately after starting the oil burner.

Diagram No. 1 shows double heat circulation from the burner to the rear of the kettle and then up and back to vent stack. Baffles D running between the melting tank and the furnace shell hold the heat down in lower part of heating chamber until it reaches the rear of the kettle. Then heat is drawn by draft to the front of the kettle and the gases pass out through vent stack E. There is no terrific blast in one spot; the intense heat is distributed over the entire kettle and every degree of heat is used to the limit before it reaches the vent stack, it is claimed. This even distribution of heat results in immediate melting of asphalt with all danger of over heating or coking material eliminated.

The triangular shaped screen A, which extends the full length of the melting tank, divides the tank into two reservoirs: B for cold material; C for hot, melted material (See diagram No. 2). The triangular shape of this screen forces the cold material against the sides of the melting tank, thereby getting full effect of the evenly distributed heat. The material melts immediately and passes down the sides of the kettle as well as through the holes in the screen into the reservoir C. Cold asphalt can be added in any quantity at any time without chilling the hot, melted material.

The kettle is made in 110, 165 and 210 gallon sizes. It can be loaded to its full rated capacity.

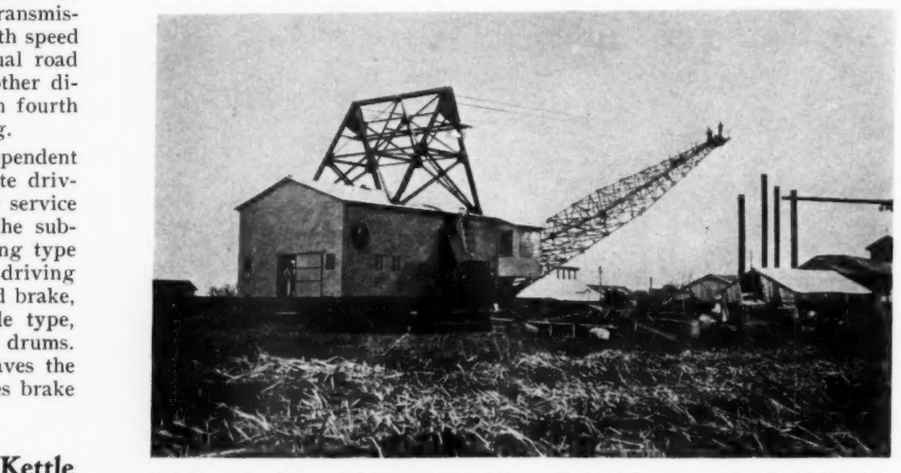
The No. 84-HD kettle is mounted on a chassis of unusual strength and trailing quality which is cushioned on semi-elliptical springs. Timken roller bearings in the rubber tired wheels mean that a trailing speed of 20 to 30 miles an hour can be maintained mile after mile with no harm to the outfit.

Monighan 6150 Walking Dragline Excavator

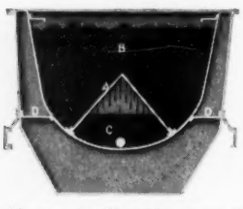
Few machines for heavy excavation have developed as rapidly as the Monighan walking draglines, put out by the Monighan Mfg. Co., Chicago, Ill. The latest development in the enormous walker type dragline for Mississippi River levee construction consists of a 375-ton machine mounted on the largest walking device ever attempted, equipped with a 150-foot boom and arranged to carry a six-yard dragline bucket.

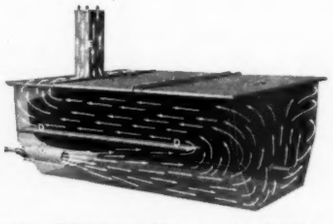
The ability of this large machine to maneuver easily has brought out new possibilities in the way of operating systems, and has established a new record for cheap earth handling and movement. The greater working reaches necessary to complete the larger levees with one handling of the materials, is obtainable through the enlargement of the boom length and through the ability of the machine to sidestep at right angles to the levee section proper.

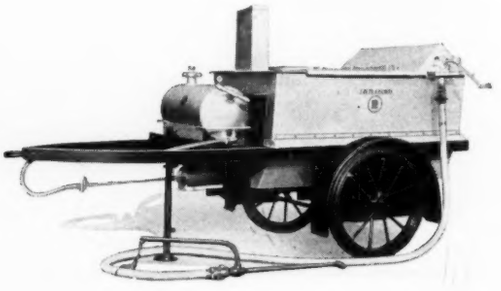
The power plant consists of a full diesel type Fairbanks-Morse engine, five cylinders, 14 x 17, 250 r.p.m., 300 horse power. This engine drives the main machinery drum set direct through belting and the swinging machinery is controlled by the Ward-Leonard electric method of voltage con-



375-Ton Monighan Walking Dragline, 150-Foot Boom, and 6-Yard Bucket



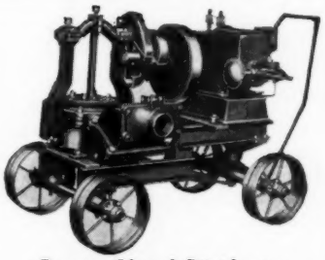




Above, Left: Diagram No. 2: Center: Diagram No. 1; At Right: Maintenance Kettle

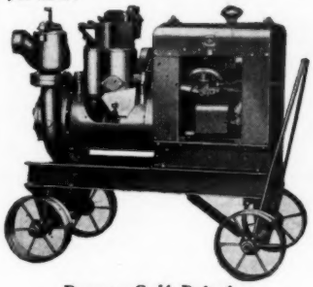
BARNES

MEANS DEPENDABILITY IN DRAINAGE PUMPS



Barnes Closed Diaphragm Pumps

The best general utility pump you can buy at the price. Change from open spout to hose discharge in two minutes. Maximum suction lift 25 feet. Total head, lift and force, 35 feet. Capacities from 3000 to 26000 gallons per hour.



Barnes Self Priming Centrifugal

Fast, positive, automatic. Self priming on any suction lift up to 27 feet. No foot valve needed. Even a leaky suction line will not stop the pumping. Self priming feature *increases* capacities over that of regular centrifugals.

Barnes Plunger Trench Pumps

Spill the water at the pump or force it under any head up to 50 feet. Maximum total head 75 feet. Capacities up to 15,000 gallons per hour. In continuous operation on many jobs, day and night, for weeks at a time. No diaphragms to wear out.

Barnes pumps have a reputation for seeing the job thru—getting rid of the water in any emergency.

It took more than good pumps to build that kind of a reputation. For a third of a century the sincere interest of the whole Barnes organization has centered on seeing that every Barnes Pump lives up to its name.

Today the performance of the 1930 line of Barnes Pumps is adding new proof of the fact that—YOU CAN ALWAYS DEPEND ON BARNES.

Buying a drainage pump this year? Then get the facts about a Barnes. Use the coupon.

You can always depend on Barnes

The Barnes Manufacturing Co.

MANSFIELD, OHIO, U. S. A.

BARNES DRAINAGE PUMPS

BARNES MANUFACTURING CO.
MANSFIELD, OHIO

Send complete information on Barnes Drainage Pumps.

Name .....

Street .....

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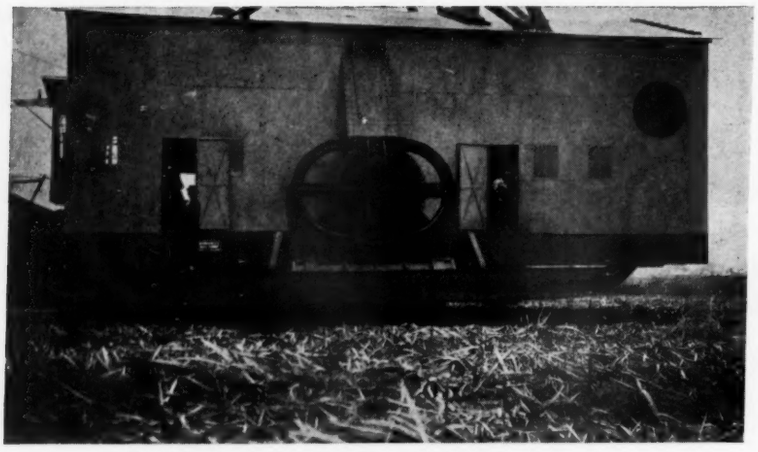
P.W.



Monighan Walking Device on 375-Ton Dragline

trol giving greater flexibility as to speed and pull.

The operating base diameter is 30 feet 8 inches and the rail circle is 30 feet in diameter. The machine is equipped with the "Newton" double rail full floating turntable, a long life anti-friction device invented by Captain W. T. Newton of the U. S. Engineer Corps located at New Orleans Office.

The weight of the machine is so distributed onto the base and walking pontoons that the bearing pressure per square inch is only 6½ pounds. This low bearing pressure insures operation without mats or timbering upon extremely soft ground.

The walking device allows maneuvering ability in any direction immediately by merely swinging the upper or revolving frame into the direction that travel is required, contracting the control and proceeding. This increased flexibility of movement and greater stability of footing allows the dragline machine to command a leading place among the machines available for building the larger section levees called for in the present flood control plans for the Mississippi valley.

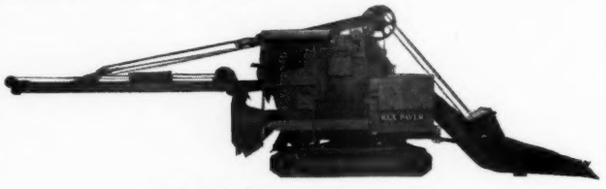
Five Dirt Moving Requirements in One Machine

The Ball Wagon Grader combines five dirt moving requirements in one piece of equipment—it digs, loads, transports, dumps and spreads.

The manufacturer states that 8c, 10c, 12c and 14c dirt moving costs are not at all unusual, and numerous jobs can be cited where these costs have been obtained on street construction, roads, dams, airports, subdivisions, cuts, fills and leveling.

One man handles the unit (two digging buckets of 40 cu. ft. capacity each) and is able to control the cutting depth and load the buckets to heaping capacity without scarifying when working in hard gravelly clay, hard adobe, gumbo, oil and gravel roads, silt, sod, etc.

A seven-foot spreader blade at the rear of the Ball Wagon Grader carries from 9 to 14 additional cubic feet of dirt and is of great value where spreading must be limited to thin layers for rolling.



1930 Model Rex 27-E Paver

Designed with an extremely short turning radius, the grader and tractor can be turned in a 16-foot roadway. When two Ball Wagon Graders are used in train the short-turning radius is increased to 20 feet.

The Blaw-Knox Company, Pittsburgh, Pa., will furnish detailed information about the Ball Wagon Grader and its dirt moving economies, upon application.

Rex. 27-E, 1930 Model Paving Mixer

The Chain Belt Company, Milwaukee, Wisc., has announced the new Rex 27-E paver. Built from an entirely new angle the Rex Champion is designed to take care of present and future specifications which call for dryer, quicker setting concrete. The drum with new blades and buckets provides greater leverage for moving dry, heavy and sticky concrete quickly and easily. Fast in handling dry concrete it is still faster in handling present day ordinary specifications.

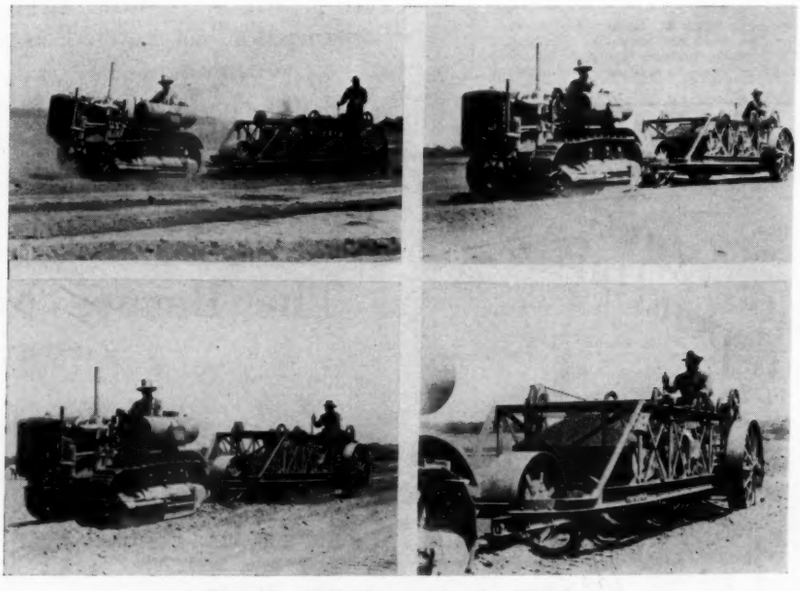
The Rex Mechanical Man, the only fully automatic control in which the cycle can be speeded or slowed, is operated by a one-step foot control for 1930. The skip, wide enough for dual pneumatics, rises to an angle of 52 degrees in 8 seconds when the automatic anticipating governor opens the engine wide.

The bucket with a straight line drop levels the entire batch into a broad, flat ribbon of concrete and the power boom swing swings the boom wherever the operator wants it by the moving of a single lever. A lower, stronger top frame and an over strength chassis make this mixer more compact and stronger.

New Trackson Shovel for Constructors

A new Trackson shovel has been developed by the Trackson Co., Milwaukee, Wis., to handle such jobs as excavating, stripping, levelling, spreading, grading, bulldozing, and carrying dirt, cinders, crushed rock, etc. It is suitable for sand and gravel companies, pit and quarry operators, rock products manufacturers and many other companies who handle coal, waste materials, etc. in and around their plants.

This new shovel is built of special



How the Ball Wagon Grader Works

LAWTON, Okla.—*A Simplex mechanical surface aeration plant of ten units, designed by the Benham Engineering Company, Consulting Engineers, Oklahoma City. Guaranteed Capacity* 800,000 *G.P.D. Actual Capacity* 1,000,000 *G.P.D.*

SIMPLEX
Mechanical Surface Aeration

Modern Efficient Economical

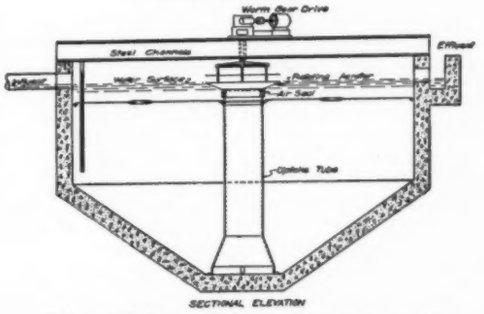
THE Lawton Sewage Purification Plant pictured above provides additional proof of the economy, efficiency and flexibility of the Simplex Aeration type plant.

Although our recommended capacity for a Simplex installation of this size is 800,000 gallons per day of normal strength domestic sewage, the Lawton plant has successfully handled flows in excess of 1,000,000 gallons per day of strong sewage.

Purification without odors or psychoda fly nuisances may be had with an installation of Simplex Aerators.

Write us for complete information.

Single Simplex AERATOR unit in tank



The revolving aerator receives its sewage through the uptake tube from bottom of tank and is equipped with vanes that throw an upper and lower film of sewage over the surface of the tank. Oxygen absorbed by the films, the surface agitation and complete circulation of sewage will give any degree of nitrification desired, determined by the detention period in the tank.

Sole Manufacturers in the United States and Canada

SIMPLEX *SURFACE* AERATOR

SIMPLEX EJECTOR AND AERATOR CORPORATION

2528 W. Madison Street, Chicago

steel castings and heavy, re-inforced structural steel. The bucket proper is made of ¼-inch steel plate with a cutting edge of special plow steel ½ by 6 inches, and it will stand up under the hardest usage, such as digging into hardpan, rocky soil and very abrasive materials. The bucket is controlled by a mechanical clutch-operated hoist.

In ease and simplicity of operation this machine is practically fool-proof. A single lever controls the bucket and an automatic clutch release eliminates any possibility of raising the shovel too high. A special feature is the bucket return, which is either power-operated or automatic, resulting in a considerable saving of time and ability to handle more material with less effort.

The new shovel has a digging range from 8 inches below ground level to 40 inches above. The sharp cutting edge of the bucket enables it to dig into very hard surfaces, and as it is raised the bucket tilts back, preventing spillage of the material which is being carried.

A very important advantage is portability. It may be mounted either on wheel tractors or on crawler units.

Mounted on the tractor this shovel has the remarkably low overhead clearance of only 69 inches, which is especially important for work in industrial plants where it travels through doorways, etc. Also, it enables the shovel to handle such jobs as digging drain pits in garages and excavating under buildings which have been raised from their foundations and supported on blocks.

Chain Belt Mix Haul for Ready Mixed Concrete

The Chain Belt Company, Milwaukee, Wisc., has announced the Rex Mix Haul, a new development in truck-mounted mixers. After two years of experimenting in the field with various types of agitating and mixing bodies, Rex designed the Mix Haul, extremely portable, light in weight, and built to fit any make of truck. Mounted low on the supporting frame, with large charging opening, variable flow discharge chute, independent, easy turning drum with three-point anti-friction suspension, the Rex Mix Haul is an entirely self-contained unit, with its own power plant and own power take-off. The drum is driven by genuine Chabelco chain, the transmission is fully enclosed and operates in a bath of oil, and the water control is the same accurate system that is supplied on all Rex Mixers.

The volume of The Cleveland Tractor Company for February was 44% ahead, in domestic business, of the same month last year. This, in the opinion of C. D. Fleming, vice-president, may be taken as indicative of two conditions —first, that the use of all makes of tractors generally is rapidly increasing; and second, Cletrac is finding a ready acceptance among power users everywhere and the Company's large distributor and dealer's organization is alert to these facts.

NEWS *of the* INDUSTRIES

The Heltzel Steel Form & Iron Company recently announced the appointment of the following new representatives: Stuart M. Christhilf & Co., Inc., 205 Snow Building, Baltimore, Maryland; J. B. Harbison Equipment Co., 209 Spring Street, Little Rock, Arkansas; Hudson Supply & Equipment Co., Seventh & T Streets, N. E., Washington, D. C.; Kratz & McClelland, Inc., 522 Bryant Street, San Francisco, Calif.; Banks-Miller Supply Co., Huntington, West Virginia; Crook Company, 1220 So. Grand Ave., Los Angeles, Calif.; The C. H. Jones Co., 134-140 Pierpont Ave., Salt Lake City, Utah; Waterhouse Equipment Co., Inc., Jackson, Mississippi.

At a recent meeting of the Board of Directors of Continental Motors Corporation W. R. Angell was elected president of the company, succeeding R. W. Judson, who has been made chairman of the board. Roger Sherman and James H. Ferry, both of Chicago, and both large stockholders of Continental, were elected vice presidents. B. F. Tobin, Jr., is the new treasurer, succeeding R. M. Sloane, resigned. Leo M. Butzel, was elected a director of the company at the same meeting of the board.

The Portland Cement Association announces the appointment of Walter R. Macatee as district engineer in charge of association work in the states of Virginia and North Carolina with offices at 904 East Main Street, Richmond, Virginia.

At the stockholders' meeting of the Sivyer Steel Casting Company of Milwaukee, recently consolidated with The Nugent Steel Castings Company, of Chicago, the following officers were elected: C. R. Messinger, chairman of the board; L. S. Peregoy, president; M. A. Fladoes, vice-president in charge of sales; George L. Pollock, secretary; C. A. MacDonald, treasurer.

The National Equipment Corporation, Milwaukee, Wisconsin, announces the addition to its group of the C. H. & E. Manufacturing Company, 254 Mineral Street, Milwaukee, Wisconsin, manufacturers of saw rigs, pumps hoisting machinery, material elevators, and mortar mixers. The C. H. & E. Mfg. Company was founded in Milwaukee, in 1909 by Frank F. Hase, president, and others. Mr. Hase becomes vice-president and director of the National Equipment Corporation.

W. Earle Pashley, Advertising Manager of The C. F. Pease Company, 813 North Franklin Street, Chicago, Illinois, has been appointed Assistant Sales Manager and Second Vice-President. Simultaneous with that appointment Mr. Pashley was elected to the Board of Directors and in addition to his new responsibilities will continue in charge of advertising and all promotional activities of the company.

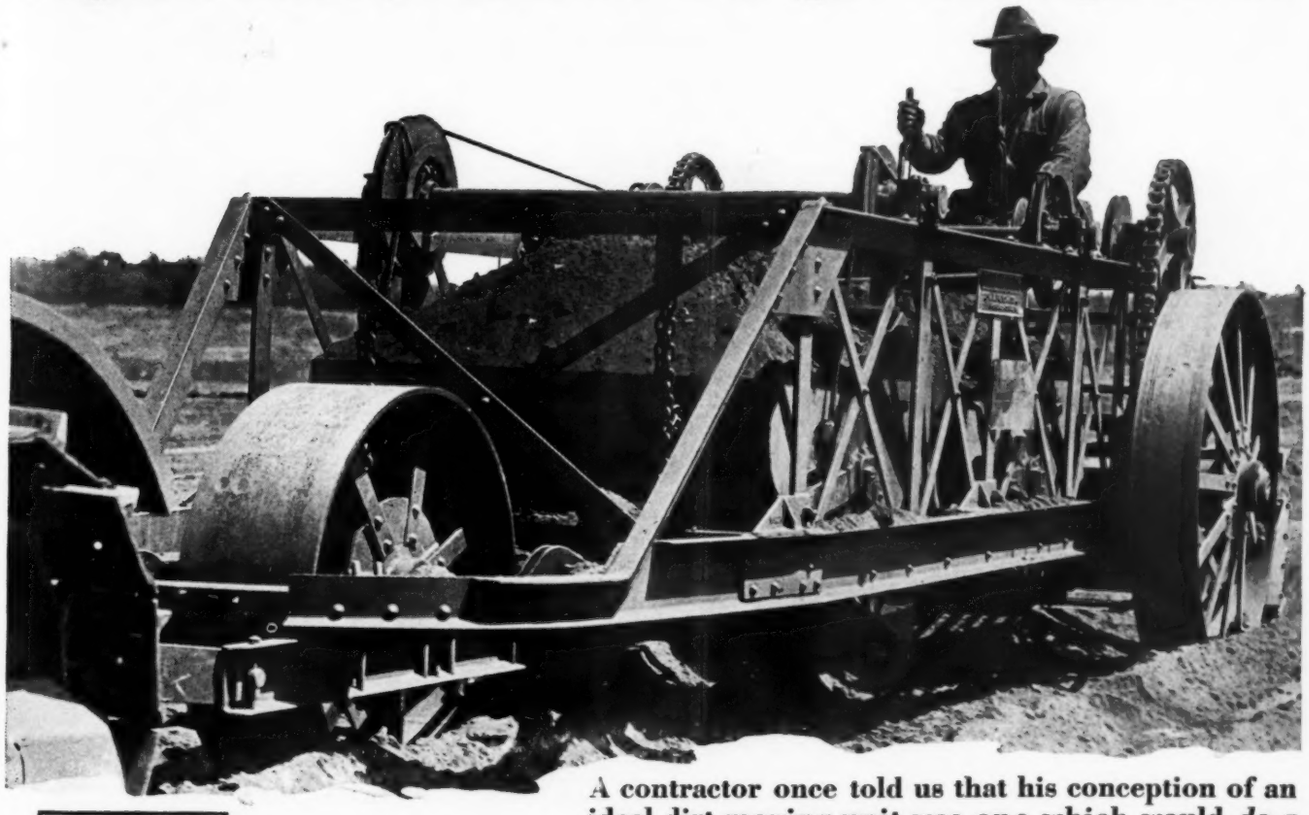
The annual meeting of The Galion Iron Works & Mfg. Co., Galion, Ohio, was held recently, and the following officers were elected: D. C. Boyd, chairman of the board; Robert W. Gillespie, president; John L. Connors, vice president and general manager; J. S. Boyd, vice president; R. E. Boyd, works manager; J. X. Farrar, secretary and treasurer. Frank W. Faber, who had been secretary and treasurer for more than fifteen years, resigned his office to engage in other activities. John L. Connors has been serving as assistant general manager of The Galion Iron Works & Mfg. Co. and also holds the same position in The Jeffrey Manufacturing Company of Columbus, Ohio. H. Supp, Jr., the new treasurer of the Company, is also treasurer of The Jeffrey Manufacturing and J. X. Farrar, the new secretary, is credit manager of The Jeffrey Company.

Wallace W. DuPre, for fourteen years sales manager of the Knickerbocker Company, Jackson, Michigan,

Rex Mix Haul for Ready Mixed Concrete

The Wagon Grader

a self contained dirt moving unit that Digs, Loads, Hauls, Dumps and Spreads



A contractor once told us that his conception of an ideal dirt moving unit was one which would *do a complete job.*

The Ball Wagon Grader does just that—and far more efficiently and at a lower cost per yard of dirt in place than any other machine known to dirt movers.

We would like to tell you about the hundreds of grading jobs which the Ball Wagon Grader has successfully handled.

We would like to show you how the Ball Wagon Grader can do your grading job quicker and at a saving.

You are interested in having this information—so please mail the coupon.

More* BLAW-KNOX *dirt moving units

Clamshell Buckets

Dragline Buckets

TRADE MARK REG. U.S. PAT. OFFICE

BLAW-KNOX

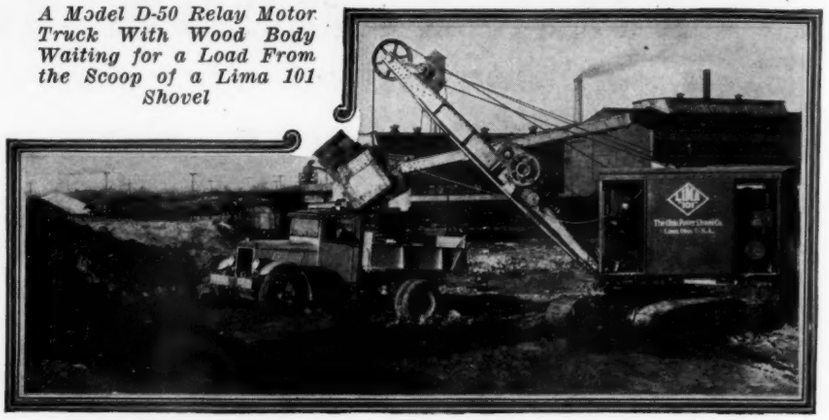
BLAW-KNOX COMPANY
2019 Farmers Bank Bldg., Pittsburgh, Pa.
Send me complete information on
Ball Wagon Grader ☐ Clamshell Buckets ☐
Dragline Buckets ☐

NAME .....
COMPANY .....
STREET .....
CITY ..... STATE .....

BLAW-KNOX

has purchased a substantial interest in the business of Thomas Brown, Inc., Baltimore, Md., and Washington, D. C., distributors of Knickerbocker concrete, mortar and plaster mixers and saw rigs, Keystone power shovels and Marlow pumps, and will make his headquarters in Baltimore. He retains his interest in the Knickerbocker Company, remains its vice-president and will give his general attention to the company's Eastern sales.

Among the new distributors who have been appointed recently to handle Trackson Tractor Equipment for McCormick-Deering tractors is the J. D. Adams Company, Indianapolis, Ind., who will cover the territory included in the Indianapolis, Fort Wayne, Richmond, Terre Haute and Evansville, Ind. branches of the International Harvester Co. and also that of the Louisville, Ky., branch. McCarthy-Jones & Allen Co., Inc., Nashville, Tenn., have been appointed distributors for the Nashville Territory, and the Option Equipment & Supply Company, R. F. D. No. 6, Mt. Oliver Station, Pittsburgh, Pa., for the Pittsburgh territory. All of these new distributors will handle a complete line of Trackson Crawlers, Shovels, Loaders, Bulldozers, Cranes, Hoists, etc. and will be able to give prompt service on orders for these machines and on repair and replacement parts.



A Model D-50 Relay Motor Truck With Wood Body Waiting for a Load From the Scoop of a Lima 101 Shovel

The Truscon Steel Company, Youngstown, Ohio, announces the appointment of Charles A. Haynes as manager of the Transmission Structures Division.

Theodore V. Wood, formerly with R. D. Wood & Company, has joined the sales organization of The Leadite Company.

Due to increased business, the Reading Chain and Block Corporation, main office and plant Reading, Pa., have added to their Cleveland Sales and Engineering Staff, under George R. Harrison District Manager, W. C. Minier and F. C. Lorenz.

Sterling motor truck sales for the first quarter of their fiscal year, beginning November 1st, showed an increase of 14 per cent over the corresponding period of last year.

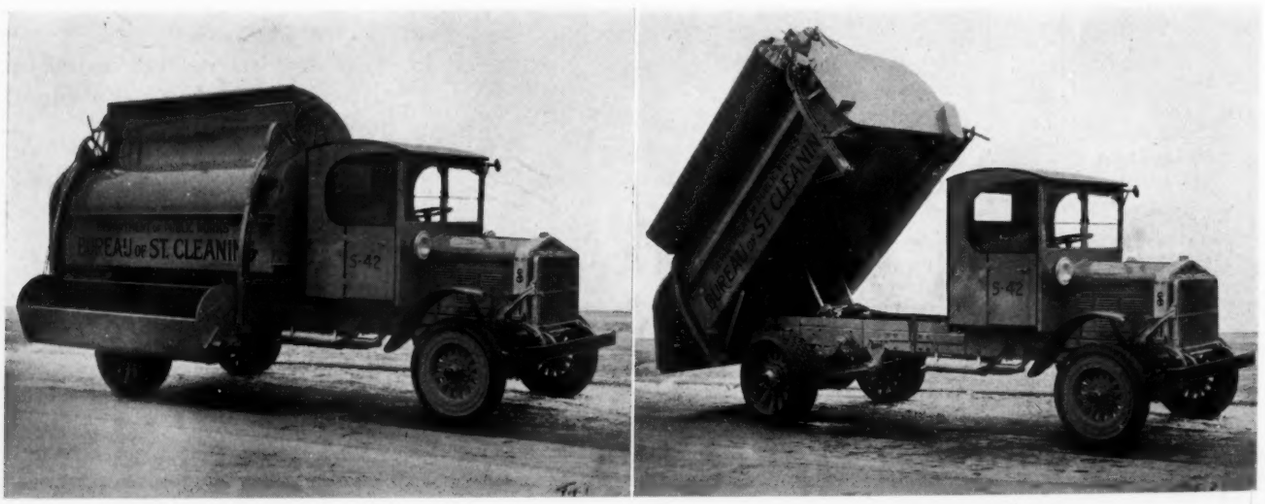
The Chain Belt Company has recently opened its eighteenth branch office at 950 Park Square Building, Boston, Mass., under the supervision of J. K. Merwin, formerly of the Cleveland, Ohio, office.

New Motor Ash Collecting Equipment in Philadelphia

The Department of Public Works of the City of Philadelphia has placed ash collection facilities on a scientific and healthful basis, with the recent installation of a fleet of motor trucks equipped with dustless ash collection bodies.

The trucks are a part of a group of thirty-four heavy duty six-cylinder Sterlings recently purchased by the city, of seven to eight-ton capacity, which permits carrying capacity loads with a surplus of power to meet every hauling requirement.

The bodies, which are of scientific design, were supplied by B. Nicoll & Co., of New York City. Due to their construction, they are not only dustless, but also claimed to be labor savers as the ash collectors have no reaching or shoveling to do when unloading their cans into the truck.

A steel trough (shown in Figure 1) lowers down close to the ground, making it convenient for the collector to deposit his load without strain or exertion. The trough operates on a davit-like mechanism with gears that lower or raise it over the sides of the truck. When filled, it is mechanically raised and its contents are dumped into the tank receptacle. A steel covering prevents dust from escaping. When the tank is filled, the trough remains in this position "hermetically sealing" it until the load is ready to be deposited at the dumping grounds.

The bodies are unloaded on the same principle as a dump truck (Figure No. 2). A door in the rear is opened and with the use of a Heil hoist, the front end is elevated and the contents dumped. The truck is then ready for another load. So far these outfits are reported to be operating in a most satisfactory manner.